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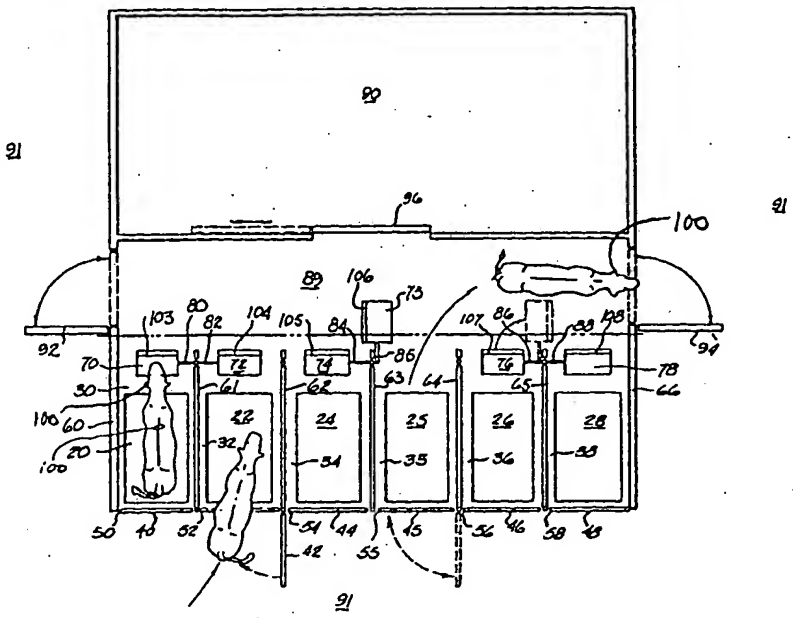

(57) Abstract

An animal husbandry system comprising an electronic identification device (100) carried by an animal and a signal receiving device (105) generally adjacent to the animal whereby the electronic identification device (100) produces an identification signal including information about the animal and the signal receiving device (105) receives the signal thereby facilitating the care and management of the animal, wherein the electronic identification device (100) has magnetic properties and may be adapted to deliver a substance to the animal and may assist in determining feed conversion efficiency.

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TITLE: Animal Husbandry System

The present application is a continuation-in-part of copending U.S. patent application Serial No. 08/843,541, filed April 18, 1997, and claims the priority of U.S. provisional patent application Serial No. 60/051,465, filed July 1, 1997.

BACKGROUND

The present invention relates to animal husbandry and, more particularly, to a system for identifying animals, for obtaining, recording and monitoring information about animals, and using animal identification and information to enhance the treatment, care and management of animals.

In one embodiment, the invention comprises an internal electronic identification device with the capacity to deliver a substance to an animal. In another embodiment, the invention comprises the electronic identification device and a reader for receiving a signal from the device. In another embodiment, the invention comprises the electronic identification device with magnetic properties and a reader for receiving a signal from the device, wherein the electronic identification device may be adapted to dispense or provide a substance to the animal carrying the device over time or on command.

The present invention provides a system for identification and control of animal: which is adapted to utilize animal data such as identification and characteristics (such as weight, temperature, blood type, DNA and the like) in a manner enabling a farmer, dairy, milking parlor, rancher, feedlot operator or the like to more efficiently and profitably control and manage animals such as beef cattle, sheep and hogs.

In one embodiment, the present system comprises the use of a stall with an exit and an entrance whereby an animal, carrying an electronic identification device, enters the stall and is positioned adjacent to an electric signal generating and receiving device (a "receiver" or "reader") a reader. An entrance gate is automatically operable from a normally open position to a

closed position to confine the animal in the stall upon generation of a gate closing signal. An exit gate is automatically operable from a normally closed position to an open position upon receipt of a gate opening signal to provide an exit from the stall to one or more of another stall, an exitway, a retaining pen or feedlot adjacent the stall. In this manner, an individual animal of a group of animals may be identified and selectively directed for any of a variety of reasons.

The identification device facilitates selection or handling of particular animals, e.g., for further routing or for retention in a retaining pen. In one embodiment of the invention, which might be used with cattle or other ruminants in a feedlot or on a ranch or farm, the identification device comprises an ear tag which is attached to one ear of each animal. In another, preferred embodiment, the identification device comprises a bolus carried in one of the stomachs of the animal. In another embodiment, the identification device comprises an implant. In any of these embodiments, the electronic identification device is an electronic signaling device which is operable to generate a identification signal.

A computer or microprocessor may employed to determine and select which of the animals is to be directed to a selected location, e.g., the retaining pen or the group of animals outside the retaining pen, or to receive treatment. The signal generating and receiving device is suitably connected to the computer to communicate the animal identification signal to the computer which signal identifies a particular animal. The computer may be suitably programmed to receive and store specific information relating to each animal in association with that animals identification. In addition, the computer may be programmed to receive and store other information about the animals, environmental information and the like. The computer may be suitably programmed to compute and correlate specific information about a particular animal with general information or compilations of specific information about the animal to enable selection decisions to be made automatically about an animal. Selection decisions may also be made by a computer operator by manual entry of data to the computer . The computer may be

programmed to send animal selection signals to a gate operating associated with the entrance gate and the exit gate of each stall. Thus, when a selection signal is generated in the computer and transmitted to the gate operating when a particular selected animal is in a stall, the entrance gate is closed to hold the selected animal in the stall and the exit gate is opened to direct the selected animal to a location.

The animal husbandry system of the present invention may be used in conjunction with a multiplicity of animal management procedures. For example, the computer may be programmed to automatically generate a selection signal at the end of predetermined periods of time to enable the selected animal to receive medical treatment such as periodic inoculations, to receive a special feed ration, to be bred during a fertility period, to be isolated for calving, to be shipped to a feedlot, to be slaughtered or to be offered for sale or the like. Any of the foregoing decisions can be made separately from the computer and inputted by the computer operator. The time of day of watering of a particular animal and the amount of water drunk by the animal can be recorded in the computer. Irregularity of appearance or the failure of an animal to enter a stall for a period of time can be recorded in the computer. The computer can be programmed to generate period (daily, weekly, etc.) information sheets about each animal for the use of management personnel and to generate alarm signals relating to particular animals.

Another feature of the present invention may be the capability of measurement of a selected physical characteristic of a particular animal. For example, the weight of the animal may be measured while the animal is in a stall on platform-type scale or the like, and a weight signal may be generated and transmitted to the computer. Thus, the gain or loss of weight of each particular animal may be recorded on a daily basis and animal management decisions made automatically or manually by the computer. The electronic identification device may be adapted to sense and communicate animal characteristics such as temperature, blood type or genetic information.

Medicinal treatment may be effected when an animal is in a stall by direct injection or introduction of a medication or other substance into a feed and/or water container. In a preferred embodiment of the present invention, medication or other substances may be provided to the animal by using the bolus of the present invention, or an attachment thereto, whether or not the animal is in a stall or other locations such as pastures or pens.

Since the electronic identification device of the present invention is placed inside the reticulum of an animal, the temperature information provided by the associated thermometer will be accurate and will give early indication of any increase in temperature to indicate a fever. It will also indicate a decrease in temperature which aids in determining when an animal goes into estrus. Observation of temperature readings will aid in detecting the proper time for artificial insemination. The system of the present invention makes it possible to identify dairy or other cattle and take their temperature as they walk by a panel reader when they enter a milking parlor or any stall or chute. Feeder calves carrying the ID device of the present invention may be monitored for fever as they go through sales barns or enter a feedlot. Readers can be placed near drinking fountains or gates, stalls or chutes where daily, or more frequent, temperatures can be observed.

The system of the present invention is particularly useful for monitoring the condition of cattle in a feedlot environment where cattle are being fed and watered to increase weight to measure an animals performance for various genetic heritable characteristics such as rate of gain, feed conversion efficiency, quality and carcass cutability prior to slaughter. In operation of typical cattle feedlots, a multitude of animals are confined in one or more relatively large-size pens in which a supply of feed and water is provided. The present invention may be advantageously utilized by providing each animal with a bolus transponder. One or more of the signal generating and receiving devices may be adjacent to the animals, the food and/or water supply or other animal containment or handling structures. The computer may include a central

large-size computer located in a building structure at the feedlot and one or more small-size microprocessor-type computers located on site at the feedlot pen areas or hospital facilities.

Evidence indicates that cattle have definite patterns of growth and weight gain characteristics. Thus, it is possible to determine when it is no longer profitable to continue to hold and feed a particular animal in a feedlot environment. In addition, some cattle in a feedlot may also become ill and it is desirable to identify such animals for treatment and/or removal from the herd. It is to be understood that the advantages of this invention may be employed with all kinds of domestic and wildlife animals and may be used in other environments such as on farms, ranches and game preserves.

In one embodiment, the invention comprises one or more relatively large animal confinement structures for generally confining a large group of animals and one or more relatively smaller animal confinement structures within or associated with the large structure for selectively confining one or a smaller group of the animals selected from the larger group of the animals. Individual stalls may be provided for receiving one animal at a time and include an entrance and exit gate for restricting entry and exit of the animals relative to a stall. A feeding and/or watering bowl or trough, may be provided in such stalls for supplying feed and/or water to an animal located in the stall. A conventional electronic platform-type scale may be located in one or more of the stalls in a position and arrangement to weigh an animal while it is in the stall. An electronic identification device is carried by each animal for generating a unique coded identification signal for each animal in order to identify the particular one of the animals. A signal receiver is placed permanently or semi-permanently adjacent to the stall(s) for receiving the identification signal transmitted from the animal. The signal receiver may also transmit a corresponding process identifying signal unique to the particular one of the animals. A computer or microprocessor may be used for correlating the identification signal and the weight signal for each animal with predetermined weight criteria. If the weight of the animal meets predetermined

weight criteria, an electronic control signal is generated for selective separation of that animal from the other animals. Suitable chutes and gates may be associated with the animal confining structures for directing the animal to a selected location based on the animal's information. The gates may be operated electronically and automatically in response to signals generated by the microprocessor, electro mechanically by an operator or mechanically.

Advantages of the present invention, particularly the electronic identification bolus include permanent international individual identification for ruminant animals, lifetime temperature monitoring for such animals and, in one embodiment, a lifetime hardware control magnet incorporated in the device. With respect to use in feedlots, the permanent individual identification number is provided for each animal. This can prevent theft, and provide identification if theft does occur, and provide source information and history for the lifetime of the animal. In one embodiment, with automatic animal management and health control provided, along with the systemic gate and chute controls, the present invention facilitates management of animals in a feedlot setting. It allows cattle feeders to track growth curves and identify optimum end point feeding for each animal, in any size group of animals, as well as to sort at any given time and day. The present invention facilitates identification and sorting of sick cattle, and it can be used to facilitate and identify individual weight gain on each animal and growth weight gained per pound on a daily basis. It permits the identification of feed conversion efficiency and ration adjustments and it also may be used to monitor water consumption.

In one embodiment of the present invention, it is anticipated that there may be a complete computerized accessible number bank for identifying all cattle world-wide, as well as for providing information about individual animal's ownership, source information and history for the lifetime of an animal. This would be advantageous for maintaining health and safety records, and to facilitate the identification of both live animals and carcasses for food safety regulations through-out the world for disease trace-back as required by individual countries.

An advantage of the present invention for breeders is that it provides permanent recorded identification on each animal, as well as estrus cycle identification and automatic sorting for A.I. estrus purposes for both beef and dairy cattle. The present invention may be utilized to provide data for calving, weaning, performance testing, marketing, feeding and carcass information. Temperature monitoring is an advantage of the present invention and can be used to assess all phases of an animal's life and provides indication of health. An advantage of the magnetic feature of the preferred embodiment of the present invention is that it eliminates hardware disease and permits the introduction of satellite delivery systems for delivering substances to an animal. Another advantage is that it enhances signal transmission.

Preferably, the bolus of the invention may be adapted to include sensors to measure acids in the stomach of an animal, including pH and propionic acids in the rumen. In one embodiment the bolus may include a timer device to identify the time of use in an animal, and a delivery system for meeting all forms of oral needs.

Other features and advantages of the present invention will become more fully apparent and understood with reference to the following specification and to the appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic plan view of one illustrative arrangement of apparatus for practicing the method of the invention.

Figure 2 is an enlarged schematic side elevational view of a portion of the apparatus of Figure 1.

Figure 3 is an enlarged cross-sectional side view of one embodiment of the electronic identification device of the present invention.

Figure 4 depicts another embodiment of the electronic identification device of the present invention..

Figure 5 depicts the device of Figure 4 partially cutaway with the bolus of the invention enclosed in a resilient housing.

Figure 6 depicts a block diagram of one embodiment of the invention.

Figure 7 is a schematic block diagram of one embodiment of the apparatus and associated electronic control system components.

Figure 8 is a schematic plan view of another animal husbandry system for practicing the invention.

Figure 9 is an enlarged schematic side view of a portion of the system of Figure 8.

Figure 10 is an enlarged schematic plan view of a portion of the apparatus of Figure 9.

Figure 11 is a schematic plan view of the stall apparatus of Figure 10 and associated identification and control apparatus.

Figure 12 is a schematic plan view of another illustrative arrangement of apparatus for practicing the invention.

Figure 13 is a schematic view of another illustrative arrangement of apparatus for practicing the invention.

Figure 14 is a schematic plan view of another illustrative arrangement of apparatus for practicing the invention.

Figure 15 is a schematic plan view of another illustrative arrangement of apparatus for practicing the invention.

Figure 16 depicts another embodiment of the present invention, namely, an artificial insemination apron for use with the bolus.

Figure 17 depicts the embodiment of Figure 16 in use.

Figure 18 depicts another embodiment of the bolus of the present invention, wherein the bolus is adapted to carry one or more of the depicted satellite delivery devices.

Figure 19 is a cross-sectional side view of a transponder according to the present invention.

Figure 20 is an end view of the transponder of Figure 19.

DETAILED DESCRIPTION

With regard to means for fastening, mounting, attaching or connecting any components of the present invention to form the system or any embodiment as a whole, unless specifically described as otherwise, such means are intended to encompass conventional fasteners such as machine screws, rivets, nuts and bolts, toggles, pins and the like. Other fastening or attachment means appropriate for connecting components include adhesives, welding and soldering, the latter particularly with regard to the electrical system of the apparatus.

The electrical components of the present invention are conventional, commercially available components unless otherwise indicated, including electrical components and circuitry, wires, fuses, soldered connections, chips, boards and control system components.

Generally, unless specifically otherwise disclosed or taught, the materials for making the various components of the present invention are selected from appropriate materials such as metal, metallic alloys, ceramics, plastics, fiberglass and the like.

The present invention comprises an animal husbandry system comprising an electronic identification device (which also may be referred to as an "EID device") carried by an animal and a signal receiver (which also my be referred to as a "reader") generally adjacent to the animal whereby the electronic identification device produces an identification signal including information about the animal and the signal receiving device receives the signal thereby facilitating the care and management of the animal.

EID device

Referring to Figures 4, 5 and 6, in one embodiment, the electronic identification device of the present invention 10 comprises a read/write scanner 12 of the type DAS-5004 manufactured by BioMedic Data Systems, Inc. of Seaford, Delaware or an equivalent thereto such as the scanners manufactured and sold by Avid Identification Systems, Inc. of Norco, California,

suitable for the purpose intended, namely, to read or write into memories carried by a transponder. The read/write scanner 12 transmits a signal to a transponder 14 located remote from the read/write scanner as for example a transponder placed in a ruminants animal. The transponder 14 may be of the type IPTT, also manufactured by BioMedic or Avid or an equivalent thereto suitable for the purpose intended. Attached to the transponder for reading by the read/write scanner 12 are a plurality of both read only (16-16N, 18-18N) and programmable/read memories (20-20N). Any number or capacity of read only or progammable/read memories may be provided.

Memories contained on the transponder chip providing useful data may be monitored by the read/write scanner 12 using read only preprogrammed memories, as for example, animal identification 18 and other data on memories 18-18N to be monitored only and unprogrammable during the life of the animal. Programmable/readable memories 20-20N, such as one containing a running log of animal medical history which can be updated periodically with current medical information or any other important information during the life of the animal. With this medical and other important information being burnt in and nonerasable external of the animal.

It should be understood that redundant information can be stored in like chips 18 and 20 or the additional chips 18A-18N and 20A-20N can be used as spares for later determined vital information on the animal.

The transponder chip is attached by any suitable means, such as by way of example, an adhesive such as epoxy or the like to the outer surface of a coated ferrite member 22 which may be a magnet such as a rectilinear block magnet or the like obtainable from Power Magnets, USA. The mmember 22 should have sufficient weight to remain in the animal throughout its life and be reusable. Preferably, the weight of the magnetic bolus is in the range of 2 to 6 ounces.

A wire antenna 26 of a suitable conductor is connected to the input/output of the transponder 14 by wrapping several turns around the member 22 over the transponder and chips

all being fixedly in place on the member 22. The antenna is likewise affixed to the member 22 by suitable means as noted above. Preferably, the field of a magnetic member 22 will be normal to the field developed in the winding 26. Thus, the permanent magnet can be used as the magnetically permeable core of the antenna winding 26 acting as an inductor. It has been found that random wrapping of the antenna about the member 22 successfully operates but under certain conditions may require increased power transmission from the reader/programmer. It has been also found that as the animal in which the bolus is placed ingests metal objects through its life that the operation of the device may improve due to the magnetically attached metal objects increasing the antenna efficiency, thereby enhancing the receiving and delivery of electronic data.

The entire device can then be inserted into a length of shrink tubing 28 or the like with the ends sealed and the tubing shrunk around the complete bolus and electronics. The shrink tubing or the like should be of sufficient thickness to withstand an animal bite when being initially placed in the animal without causing damage to the windings, transponder(s) or micro chips.

It should be understood that the transponder chip and the specific memories implanted therein are state of the art small micro-circuitry.

Figures 1, 2 and 3 depict an ear tag electronic identification device 100. The tag member 120 is made of one piece of molded flexible plastic material and a retaining button member 122 made of one piece of relatively rigid molded plastic material. Tag member 120 has a relatively large body portion 124, an intermediate tapered portion 126, a support strap portion 128 and a retaining head portion 130. Retaining button member 122 has a central slot 132 and resilient spring finger portions 134, 136. In use, a slit 138 is cut in the top of the animal ear and head portion 130 is forced through the slit and then through the central slot 132 in button member 122. Thereafter, the head portion is retained by the button member to hold the tag member in the illustrated position hanging downward in front of the animal ear. Signal transmitter 102 is

suitably fixedly mounted on tag portion 126 by integral molding there within or placement in a pouch 136, Figure 3. After slaughter of an animal, the identification tag assembly may be removed from the ear and kept on or with the carcass to enable automatic monitoring of a particular animal and generation and storage of grade and quality information. Other types of ear tag assemblies may be utilized such as those described in U.S. Patents 3,896,577, 3,958,353 and 4,102,073 or one piece plastic tags.

The identification signal generator 102 on the ear tag 100 is a conventional electronic chip device with conventional miniaturized electronic circuitry and an antenna which is capable of receiving activating electromagnetic energy and responding thereto by emitting a coded radio frequency digital signal. Such may be of the general design as apparatus currently manufactured and sold by B.I. Corporation of Boulder, Colo., and disclosed in U.S. Patent 4,475,481, the disclosure of which is incorporated herein by reference. Other designs may be used including the type wherein the identification device is battery operated and does not depend on receipt of activating energy from the signal receiver. Preferably, the animal electronic identification signal transmitting device of the present invention is a passive (no battery) electronic device, which may be encased or encapsulated in a suitable material resistant to gastric liquid (e.g., suitable plastics) that receives and stores energy from a surrounding receiving electromagnetic field generated by the reader (described below) and transmits an unique digital code to the reader. In the tag embodiment, the transmitter 102 is of relatively small size, e.g., approximately 15 to 25 mm×15 to 25 mm× 3 to 5 mm, or less, and of relatively low weight, e.g., 5 to 10 grams. The range of transmission of both the transmitter and the receiver is approximately between six inches to four feet, and the storage capacity is approximately at least twenty to thirty binary digits (bits) of data plus other digits for preamble and parity (error detection) so that the system allows for up to 1,000,000 or more different unique codes which may be programmed into the electronic chip during manufacture. Both the transmitter and the receivers are adapted to operate under

severe environmental conditions, e.g., temperatures from -30° C to + 55° C, 10% to 100% relative humidity or sprayed or condensed water. The operating frequency may be between 100 KHz and 500 Khz, however, operating frequencies up to 100 MHz may be utilized by equivalent systems.

In one alternative embodiment of the electronic bolus of the prevent invention, an outside antenna wrap of a different configuration and/or length may be used to adjust the reading distance, for example, obtain a greater reading distance from a chip attached to the bolus. In this embodiment, the wrap may be on a bolus of ferrous or either magnetic, non-ferrous material.

The shape of the bolus may be changed, for example to an octagonal shape, with an index hole (not shown) for manufacturing purposes. The octagonal shape may facilitate better retention in any animal including straight-gutted animals, such as hogs, etc. Advantageously, the antenna wrap around an octagonal shape would be symmetrical and the directional orientation for reading would be optimized, possibly increasing the reading distance further.

Figure 18 depicts another embodiment of the magnetic bolus of the present invention wherein the body of the bolus 400 includes one or more satellite anchoring or receiving places 403, for example, relieved areas 403, for receiving satellite carriers 404 in various shapes. These satellite carriers 404 may be formed of a material to be dispensed 405 wherein the material is placed around an embedded magnetically susceptible metal core 406. The metal cores 406 can be loaded with virtually any compound or substance to be ingested by the animal. Because the cores 406 are magnetically susceptible they will be attracted to the magnetic bolus and attach themselves to the same. The satellites 404 may be the carriers for substances such as growth hormones (BGH or the like) for release into the animal's system over time. Timed release may be provided by a satellite carrier with a permeable or semi-permeable exterior membrane around a material to be released (which may be in solid or gel form) or a dissolvable membrane for releasing the substance inside over a period of time. The satellite carriers 404 may be formed of

magnetically susceptible metal or include portions which are more or less susceptible to stomach acids and dissolve to provide timed release as well. The satellite carriers 404, or the bolus body, may be provided with a magnetically or electronically controlled valve (not shown) that may be actuated from an outside power and frequency source to open, thereby automatically releasing a vaccine or medication on demand. This would eliminate the need to manually run calves and cows through a manual working chute for vaccine injection.

One form of time in animal indicator may be to provide the bolus with a hole or a strip containing a material which would change color with time or erode due to stomach acids. This feature would provide a time indicator for use in the case where a second bolus is inserted into the animal at a later date.

Fig. 19 depicts a cross-sectional side view of a transponder 500 according to the present invention, and Fig. 20 depicts an end view of the transponder 500 of Fig. 19. The transponder 500 includes the integrated circuit 502 mounted on a circuit board 504 together with a capacitor 506. It should be noted, however, that the integrated circuit 502 may include in its design the capacitor 506. The integrated circuit 502 and capacitor 506 are affixed to posts 508 and to the end of a core 510, preferably formed from a ferrite material. At the time of assembly and introduction of the transponder into the ruminant animal, the core 510 may not be magnetized or magnetically biased.

As shown in Fig. 19, a coil 512 is helically wrapped about a plastic bobbin 514 having an internal dimension sized to fit over the outer dimension of the core 510. The ends of the coil 512 are connected respectively to the posts 508 extending from the bobbin 514 to the circuit board 504. Thus, the length of the wire forming the coil 512 is fixed as being an integer number of turns around the circumference of the bobbin 514 plus (or minus) the distance between the posts 508. The length of te wire of the coil, the wire diameter and electrical properties and the number

of turns around the circumference of the bobbin 514 are all determinant of the inductance of the coil 512.

The positional location of the coil 512 and bobbin 514 about the core 510 is critical to operation of the transponder 500. The transponder 500 requires a tuned coil 512 and capacitor 506 combination. Generally, this is accomplished by matching the inductance of the coil 512 to the capacitance of capacitor 506. However, when the coil 512 has to be wrapped around the bobbin 514 and placed on the core 510, the positioning of te coil 512 on the cord 510 will effect the inductance of the coil 512. Thus, the position of the coil 512 must be controlled so as to allow matching of the inductance of the coil 512 to the capacitance of the capacitor 506 in order to tune the circuit of the transponder 500. If the transponder 500 is not properly tuned, the reading and data transfer capabilities of the transponder are negatively impacted.

It has been found that by the selective placement of the core 510 within the coil 512, the responder 500 can be tuned at the time of assembly, even without optimizing the inductance of the coil 512, as the inductance of the coil 512 changes by varying the placement of the core 510. For a given set of design parameters for a core 510, including its circumference and length, the length of the wire of the coil 512 and the capacitance of the capacitor 506, by moving the coil 512 axially along the long axis of the core 510 until a tuned inductor/capacitance system is established and then securing the manufacturing process, for example by the use of a bonding agent or glue (not shown), a turned transponder 500 can be assembled. Thus, once the preferred position of the coil 506 on the core 510 is established for a given set of design parameters, turned transponders 500 can be repetitively manufactured using identical components by the uniform placement of the coil 506 on the core 510.

Reader

Referring back to Figures 1 and 2, the identification signal generator and receiver (the "reader") 103 is an electronic device mounted on or adjacent to the stall. It transmits

electromagnetic energy which powers the selected EID device and receives the radio frequency digital encoded signal therefrom. The reader may condition the identification signal for transmission to a process control microprocessor and may include an interface for connection to a scale or circuitry to condition scale output signal for transmission to the microprocessor. The reader 103 may be further constructed and arranged to receive a command from the microprocessor to sort the animal and to send a signal to a control interface which may be integrated for actuating the gate mechanisms and or medicating the animal. The reader 103 may be provided with the capability of detecting when an animal is drinking and being weighed, but not transmitting an identification code, a condition that indicates a malfunction in the electronic identification device 100 or a lost device, so that the animal may be sorted and/or an alarm message may be sent to the microprocessor. Preferably, the reader is packaged in a waterproof, sealed plastic or stainless steel case and is operable by 110 volts A.C., one amp capacity. The range is such as to activate and read the electronic identification device 100 between approximately 6 inches to 3 feet, so long as not to activate nor read the electronic identification device of an adjacent.

In Use

One illustrative embodiment of the system is depicted in Figure 1. The depicted system comprises an internal electronic identification device 100, such as the bolus of the present invention, carried by the animal(s).

The system further comprises a plurality of platform type electronic weighing scales 20, 22, 24, 25, 26, 28 located in separate stall spaces 30, 32, 34, 35, 36, 38 having automatic electronically operable and closeable entry gates 40, 42, 44, 45, 46, 48 for entrance openings 50, 52, 54, 55, 56, 58 at the entry end of each of the stall spaces which are defined by spaced parallel sidewall or rails 60, 61, 62, 63,64, 65, 66. A feed and/or water bowl 70, 72, 74, 75, 76, 78 may be mounted at the exit end of each stall on automatic electronically operable openable and closeable exit gate 80, 82, 84, 85, 86, 88. The entry gates 40–48 are normally open, as indicated by gate 42, and the exit gates 80–88 are normally closed. In stalls without a feed and/or water bowl, the animal may be driven into the stall. After an animal enters a stall and is in the position shown in stall 30, the associated one of the entry gates may be closed, and the reader 105 actuated, either manually triggered or automatically triggered, to actuate the bolus 100 and, in turn, read the signal transmitted by the bolus 100.

Referring to Figure 1, readers 103, 104, 105, 106, 107, 108 may be mounted in or adjacent to each stall or feed/water bowl so that when an animal is in proximity thereto, such as when feeding or drinking therefrom, a unique coded identification signal is generated by the bolus 100 which identifies the animal in the associated stall. Each of the readers 103 are connected by suitable cables to a power supply and associated electronic data processing apparatus as hereinafter described.

After an animal in a stall has been identified and information about that animal has been gathered or communicated, the associated one of the exit gates 80–88 is opened as shown by gate

85 to enable the animal to exit the stall. An exitway or pen area 89 is located opposite the stall exits. Selectively openable and closeable control gates 92, 94, 96 may be used to direct a selected animal or animals to a holding pen 90 while other animals are directed back into the general herd population kept in an enclosed feedlot or pasture area 91.

Referring to Figure 2, the construction and arrangement of the stall may be such that the animal must stand on an associated scale 20 while the animal is in the stall. Furthermore, the size of the stall is approximately equal to the size of the animals so that freedom of movement of an animal is restricted after the animal enters the stall whereupon an entry gate control signal may be generated to cause the associated one of gates 40–48 to move to the closed position. In another embodiment of the invention, the animal may enter and exit the stall through the same entryway until a select signal has been generated. After the animal is in position in the stall and the identification signal has been generated by the associated one of the signal receiver 103–108, a weight signal is generated by the associated scale 20–28 and electronically processed in conjunction with the unique coded identification signal of the particular animal. After a predetermined time sufficient to enable the animal to finish drinking from the bowl or upon occurrence of a predetermined condition relating to the amount of water in the bowl, an electronic control signal is generated to cause the associated exit gate 80–88 to be moved to the gate open position whereupon the animal will move into the control chute or pen 89. If the animal exiting the stall is to be returned to the general herd population, return gates 92, 94 are opened and retaining gate 96 is closed. If the animal is to be separated from the general herd population, the return gates 92, 94 are closed and the retaining gate 96 are opened to provide an exit path enabling the animal to only enter the retaining pen 90. After the animal exits the stall, the stall exit gate is closed and the stall entrance gate is opened to enable another animal to enter the stall. The bowl may be kept full of water automatically by suitable float valve (not shown) connected to a supply of water through a suitable hose 114 (not shown) or the bowl may be

supplied with a feed ration through suitable overhead conveyor 115 (Figure 2) and associated feed ration dispenser 116.

An exemplary data processing and control system is shown in Figure 7, and includes a central computer 140 which is capable of receiving electronic animal identification signals and animal weight signals; storing and comparing animal identification, weight and other animal related information; and receiving and generating appropriate system control signals. The computer 140 may be located in a building or other environmentally controlled structure and may be connected to one or more multiple-stall feed-watering-weighing stations as well as to other data processing and storage devices 142. Each multiple-stall feed-watering-weighing station, such as the one shown in Figure 1, may include a process control microprocessor unit 144 for receiving animal identification signals from the identification device 103–108 associated with each stall through an interface 146 and weight signals from the scale 20–28 associated with each stall through an interface 148. The microprocessor unit may be used to store and/or record the identification number and the weight of the individual animals and transmit the information to the computer which is connected to the microprocessor unit through a central control 149 to receive and send information and control signals there between. Each of the gates is operable by a gate actuator 150, 152, 154, 156, 158 in response to control signals received through control interface 160, 162, 164, 166 from process control microprocessor 144. In addition, any auxiliary mechanisms such as feed or medicine dispensers are operable by an actuator 168, 170 in response to control signals received from process control microprocessor 144. It is to be understood that various control and data processing apparatus, including related circuitry and software, may be modified and varied as necessary or desirable to achieve the desired results or variations thereof.

In the exemplary data processing and control system, analog signals representative of animal weight are transmitted from conventional electronic scale 20 to interface 148 for

conversion into a digital weight signal representing the weight of the animal. The digital weight signals are transmitted from interface 148 to process control microprocessor 144 for transmission to the computer 140 through central control 149. The process control microprocessor may receive and store identification and weight data for a period of time and then transfer the data to the computer via the central control unit which converts the data signals to a high level protocol suitable for communication with the computer.

The system may be arranged so that an animal is not separated from the general herd population until after a sufficient period of time to enable processing of the last recorded weight data. For example, the weight data obtained during the confinement of an animal in a stall may be stored by the process control microprocessor or the central control for a period of time, e.g., 6 to 12 hours, before being transmitted to the computer. In this situation, the animal is allowed to return to the general herd population after an identification and weighing process is completed. After the prior acquired weight and identification information is transmitted to the computer , and appropriate calculations and comparisons have been made by the computer, the computer transmits an animal hold signal to the process control microprocessor which may be stored in the microprocessor. Then, the next time the animal enters a stall and is identified, the prior generated animal hold signal will become effective to initiate the separation process for that particular animal.

The system may include micro switches and/or photoelectric eyes associated with the various entrance and exit gates to indicate the passage of animals and closing or opening of the gates. Displays and printouts associated with the computer or the process control microprocessor may provide operators with specific information about specific animals which have been separated from the general herd population as well as specific information about specific animals still in the general herd population.

The microprocessor 144 is a microprocessor-based electronic device that contains the circuitry and memory to communicate with the identification device and scale and store one weight for each animal for each stall confinement for one period of time. The weight recorded may be the beginning, ending or average weight recorded. In addition, recorded information may include medical history, and/or management and performance history. The microprocessor also communicates with the computer via the central control as programmed or as requested, and is able to download all data records to the computer. In addition, the computer 140 is able to send data to the microprocessor 144 to update the animal records or to instruct it to initiate animal separation via the identification device.

The microprocessor 144 may have the added functions of being a local monitor of each group of stalls by inclusion of a keyboard and display allowing the operator to gain access to and add data stored in the microprocessor at the stall site. Such data could include the weight of each animal, the date each animal was put into the pen, the total number of animals in the pen, and a list of the animals sorted for yesterday or so far today and the reason for the sort. The microprocessor may also provide a report of exception animals, indicating animals that should be in the pen but are not being identified. Such a report would help the operator locate animals with lost or defective electronic identification devices.

The microprocessor 144 may also perform fault detection of the system in the stall area by receiving information on non-operating scales, an animal being weighed but not identified indicating a lost or malfunctioning tag transmitter and malfunctioning of the identification device. If any malfunctions occur, a light on the microprocessor will be lit. When an operator checks the microprocessor, he can, via the keyboard, request that the malfunction conditions be displayed. He can then take appropriate action to correct the reported malfunction. In addition, the microprocessor will transfer all such information to the central control or the computer to provide for central monitoring of malfunctions. The microprocessor may be packaged in a

stainless steel or other non-corroding weather tight sealed enclosure and/or placed in a building structure. The electronic components are conformal coated and all electrical connections to power or communication cables are through sealed conduit connections. The microprocessor 144 may have an externally accessible sealed membrane-type keyboard and be operable at 110 volts A.C., five amp capacity, through a fused switch box with suitable filters to suppress line noise and transients. Such a microprocessor will poll the status of all weigh/identification stations in less than two seconds. If a sort status exists for an animal, the sort sequence will be actuated on a second poll so that the animal sort will begin no more than four seconds after the animal is identified as being at the station. The microprocessor should be designed to operate during very low and very high ambient temperatures. Heaters, internal to the enclosure, may be provided to maintain suitable temperature for the electronic components and sealed to prevent ingress of moisture so that operation will not be affected by rainfall, spraying or continued exposure to relatively high humidity.

The central control 149 serves as an interface between the control microprocessor 144 and the central computer 140. The central control 149 accepts communication signals from the central computer and converts the data format into one suitable for transmission over the communication lines to the microprocessor. Signals coming to the central computer 140 from the microprocessor units are received by the central control and are converted to signals the central computer can accept. The central control also buffers signals from the microprocessor units by insuring the central computer is on line and ready to receive before allowing data to be transmitted. The central control will communicate to the microprocessor units in such a way that the data traffic on the communication lines is managed and microprocessor communications do not interfere with one another. The central control provides filtering so that noise or power spikes coming in on the communication lines are not transmitted to the central computer. The central control may also serve as a local system monitor. If communication is lost with any

microprocessor unit, it will light an alarm light and the display will indicate the nature of the malfunction. The status of each microprocessor and all data available at the microprocessor can also be requested and viewed at the central computer. The central control unit may be packaged in a shielded plastic computer terminal box, have a sealed membrane keyboard, and be operable by 110 volts A.C. with a dedicated 15 amp circuit with a capacity for controlling from one to five hundred microprocessor control units to provide a relatively large total system capacity, e.g., 300,000 or more animals.

The control interface, which may be integrated into the identification unit, is an electronic device that receives a signal when a sort of an animal being weighed is to occur. When this signal is received, the control interface switches power to an actuator, whether electrical, air or hydraulic, and starts the sort sequence. The control interface also monitors switches or other feedback mechanisms on the mechanical hardware to detect and signal the microprocessor when jamming or malfunctions occur.

The central computer 140 is preferably a hard disc, real time, multi-tasking computer with suitable software for two-way communication with the central control and proper data transfer there between.

It is an advantage of the system of the present invention that all useful information about an animal may be recorded and entered into the central computer in association with a particular unique code. Such information may include age, breed, initial weight, general health, source, and date of entry into the feedlot. In addition, the central computer may be provided with suitable data bases indicating average weight increase, maximum expected weight increase and length of time and amount and cost of feed for weight increase for animals of particular age, condition, breed, physical profile measurements, etc. Thus, the computer can be programmed to select a particular animal for slaughter or for resale at the most appropriate and profitable time. As weight information is generated during the feedlot feeding process, the information may be

continuously stored in the computer and used to generate data showing such matters as total weight increase, daily weight increase and the like. Such data can be compared and correlated with standard models included in the computer data base. The selection of animals may be controlled automatically by computer generated information or by review of the information by an operator.

Figures 8-11 show an embodiment of the invention wherein separate groups 200, 202, 204, 206, 208, 209 of stalls 210, 211, 212, 213, 214, 215, 216, 217 are separately located in large-size fenced feedlot-type pens 220, 221, 222, 223, 224, 225 which may be arranged in parallel rows with a central passageway 226 there between. Each group of stalls is spaced from a section of fence 227 of the associated pen to provide a retaining pen 228 defined by fence sections 229, 230 while also providing passageways 231, 232 connected to central passageway 226 by suitable gates 233, 234. Each retaining pen 228 is connected to central passageway 226 by suitable gate 235.

As shown in Figure 8, each group 200 of stalls is constructed and arranged in adjacent stall pairs 210 & 211, 212 & 213, 214 & 215, 216 & 217. Each stall of a pair of stalls has an entryway 240, 241 with an associated entrance gate 242, 243, an exitway 244, 245 with an associated exit gate 246, 247, a platform type scale 248, 249, and a water bowl 250, 251 reachable by an animal only from within the stall. Entrance gates 242, 243 are normally open so that cattle may freely enter any one of the stalls to obtain water from the associated watering bowl 250, 251 which may be the only source of water in the pen 220. In order to obtain water, each animal must fully enter one of the stalls and stand on the associated scale 248, 249. Exit gates 244 & 245 are normally closed so that each animal must back out of the stall after drinking water therein. When an animal has been selected for separation from the general herd population in main pen 220 and after the selected animal enters a stall, the associated entrance gate is closed and the associated exit gate is opened whereby the only exit from the stall is into the retaining

pen 228. After the selected animal exits the stall into the retaining pen, the associated entrance gate is opened and the associated exit gate is closed. Fence sections 255, 256 close off spaces adjacent the stalls so that the selected animals cannot escape from retaining pen 228 except through gate 235 which is normally closed until selectively opened by a feedlot operator for the purpose of removing a particular animal or group of animals.

A presently preferred construction for the stall comprises a relatively long length fixed common dividing wall 260, Figure 6, and relatively short-length fixed opposite side wall 261, 262, made from a length of metallic pipe material or the like with leg portions 264, 265 (Figure 10) fixedly embedded in a concrete pad 266 alongside of the scale. Each entry gate 243 comprises a length of pipe or the like bent into a curved U-shape configuration with end portions 267 pivotally mounted on side rail pipe 261, 262 by suitable bracket 268 for movement from a vertical position to a generally horizontal position as shown in Figure 10. An exit gate actuator 269 and control 270 are suitably mounted on rail 262. Each gate may comprise a U-shape pipe frame 272 pivotally mounted on fixed rail leg portion 274. An exit gate actuator 276 and control 277 may be mounted on fixed leg portion 274. Water bowls 250, 251 are mounted in an enclosure 280 having a side wall 282 preventing access to the water bowl from the retaining pen 228 and a top wall 284 for mounting of the identification signal receiving 286, 288, Figure 11.

Figure 11 is a schematic representation of a pair of the afore described stalls 216, 217 with scale 248, 249, exit gate 246, 247, water bowl 250, 251, gate control and identification signal receiving 286, 288. Identification signal transmitting on an animal EID device are illustrated at 300, 302. The identification signal receiver is packaged with a microprocessor and suitable interface as previously described and adjacent packages are interconnected by suitable transmission cable 304, 306.

Each interface unit is connected to an output cable 310, 312 from the associated scale; control interface devices 314, 316 which operate the gates; 110 volt A.C. power supply cables

318, 320; and microprocessor control units 330, 332 operated by 110 volt A.C. power through cables 334, 336. The microprocessor control units are connected in series or in parallel to central control 338 which is connected to central computer 340. The electronic and control devices of the system operate as previously described with reference to Figure 1.

Figure 12 discloses or depicts another embodiment of the present invention wherein a partition 600 is placed in a feedlot between the water 602 and the feed trough 604. The partition 600 has multiple ports 606 spaced to make it easy for animals to gain access to the feed bunk 604. The ports 606 are walk-through type ports and have closure bars so that after the animals are accustomed to going back and forth through ports without scales, the ports without scales can be closed off one at a time to direct the animals to use only a particular port, such as a port 606, provided with a scale 608 and one or more readers 610 to read the internal magnetic electronic identification bolus device showing the I.D. number of the animal, its temperature, and the weight. Additional readers 610 may be provided between other ports 606. The partition 600, which may be permanent or portable and may be comprised of separate partition elements or pieces, may be thought of as a barrier with a plurality of openings 606 for an animal to voluntarily walk through at least one of the openings whereby the animal passes a data collector adjacent to at the least one of the openings. It is anticipated that the animal will be carrying an electronic identification device, but analog measurements may be made in conjunction with electronic data collection or alone.

The partition panels 600 are fairly close to the feed bunk 609, whereby the animal goes through to eat and will leave once its had its fill. Because the animal is weighed both on the way in and out, the individual feed intake can be used to calculate feed conversion efficiency on each animal. Thus, cost calculations include the cost of each pound of gain in terms of feed. It also has the advantage of identifying the growth curve of each animal and identifying the optimum economical end point, temperature, ID, pH, etc.

Figure 13 depicts a modification for a stall for use in the present invention wherein a short stall 612 is provided extending out only about 18" from the water or feed trough 614 for each animal. A scale 616 may be provided. When the animals need to be sorted based on the data collected using the short stalls 612, the animals may be put in a pen and sorted in accordance with the present invention.

Figure 14 discloses another alternative embodiment of a pen and gate system for use in the present invention wherein a two-pen sort system is provided. The advantage of the depicted system is that it is possible to sort many animals with one sort gate 620 and by natural movement toward the feed bunk. Another embodiment of this type of system using bi-directional sort gates 622 is depicted in Figure 15. In this embodiment, cattle are sorted in a single sort stall into one or more pens and the bolus can be read on the way in or out of the pen. The embodiments of the system of the present invention depicted in Figures 12-14 comprise animal confinement and sorting structures which are formed from similar basic components, e.g.,. fencing, stalls, bars, pens, gates and the like, as the previously described embodiments.

Another alternative embodiment of the present invention is depicted in Figures 16 and 17. Figure 16 depicts an artificial insemination (AI) estrus cycle apron 630 for vasectomized bulls. The apron includes a neck attachment strap 632 and belly band 634 with a main apron portion 636 connected thereto and extending between the two straps. The main apron portion 636 fits on the breast of an animal, generally between its legs, but, in one embodiment, as depicted, the apron includes two leg holes 638 for accommodating the front legs of a bull, and a generally centrally mounted transmitter and receiver pocket recorder 640 with an associated pressure switch 642. The AI apron 630 is depicted in use in Figure 18 wherein a bull is depicted riding a cow. The cow carries the electronic bolus 100 of the present invention and the bull is wearing the AI apron 630. This embodiment of the present invention can provide the exact time of estrus recorded on each cow, and each time a bull jumps the cow the pressure switch turns the recorder

on to record the number of the bolus of the cow that is being ridden along with the time of day. This information can be then transmitted to a computer for printing out for the herd owner to identify which animals need to be bred and when.

Preferably, the animal-carried electronic identification device 100 (whether in the form of a bolus, tag or implant (not shown)) comprises a small size electronic chip-type device, an electrical circuit and an energy receiving antenna for operation only in response to energy transmitted thereto from an external source. The external energy source emanates from the identification signal receiver 103 and comprises electromagnetic energy.

In one embodiment of the invention, the condition of the animal is determined during a first occasion of in a stall and the condition signal is stored until the same animal is again identified during a second subsequent occasion in the stall. Then the selection control signal may be utilized to selectively direct the animal to a retaining area. It is to be understood that a selection control signal can be generated and utilized at any time by any means including manual entry at the microprocessor unit or the central computer by a computer operator.

The method of the present invention may include automatically correlating an animal identification signal and condition signal, comparing the condition of an animal with pre-established condition criteria and generating control signals for further processing of the animal including an animal separation control signal when the condition of the animal meets pre-established animal condition criteria.

The method of the present invention may include recording and storing data representative of the time when the animal enters a stall and the time when the animal leaves a stall; recording and storing data representative of the ambient temperature at the time when the animal is in the stall; recording and storing data representative of the amount of water drunk by the animal in the stall; and periodically printing a compilation of recorded data relating to the condition of each animal.

Although a description of preferred embodiments has been presented, various changes including those mentioned above could be made without deviating from the spirit of the present invention. It is desired, therefore, that reference be made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

CLAIMS

What is claimed is:

1. A system for animal husbandry comprising:

an internal electronic identification device carried by an animal, said internal electronic identification device capable of emitting a signal;

an electronic reading device generally adjacent to the animal, said electronic reading device capable of reading the signal; and

a processing unit operably coupled to the reading device and programmed to receive and process the signal.

2. The system according to claim 1, wherein the internal electronic identification device further comprises a magnet.

3. The system according to claim 2, wherein the internal electronic identification device further comprises a sensor for sensing a characteristic of the animal.

4. The system according to claim 3, wherein the characteristic of the animal is a characteristic selected from the group consisting of temperature, pH and location of the animal.

5. The system according to claim 1, wherein the internal electronic identification device further comprises a dispenser for delivering a substance to the animal.

6. The system according to claim 5, wherein the substance delivered to the animal is a medication.

7. The system according to claim 6, wherein the medication is selected from the group consisting of antibiotics and growth hormones.

8. The system according to claim 2, wherein the internal electronic identification device further comprises a dispenser for delivering a substance to the animal, said dispenser comprising a magnetically susceptible portion.

9. The system according to claim 8, wherein the internal electronic identification device further comprises a sensor for sensing a characteristic of the animal, wherein the characteristic is selected from the group consisting of temperature, pH and location of the animal.

10. The system according to claim 9, further comprising a scale.

11. The system according to claim 10, further comprising a stall, said scale adjacent to the stall.

12. The system according to claim 11, wherein the processing unit receives the signal from the reading device and compares a more recent signal to a previous signal.

13. The system according to claim 12, wherein the stall has a gate, said system further comprising a controller operably coupled to the processing unit for controlling the gate for enabling control of the animal.

14. An electronic identification device for an animal comprising:

a permanent magnet;

a transponder chip;

at least one read only memory containing information of said animal carried by said transponder chip;

an antenna connected to said transponder chip for transmitting said information when said transponder is excited, said antenna comprising a plurality of wire windings around said magnet; and

a magnetically susceptible member for providing a substance to the animal.

15. The device according to claim 14, further comprising a reader for exciting said at least one transponder and reading said information.

16. A method of automatically monitoring a physical condition of an animal comprising:

providing an identification signal sending device for the animal;

providing a stall;

causing an identification signal to be automatically generated from said identification signal device of the animal while the animal is in the stall;

determining a condition of the animal while the animal is in the stall and generating a condition signal representative of the condition of the animal;

correlating the identification signal with the condition signal and automatically comparing the condition of the animal with predetermined criteria to provide a selection control signal for the animal;

treating the animal in response to the selection control signal..

17. The method of claim 16, wherein the identification signal device is internal to the animal.

18. The method of claim 17, wherein the identification signal device is magnetic and provides for dispensing a substance to the animal.

19. A bolus for oral administration to a ruminant animal and for retention in the rumen or reticulum of the animal, comprising:

an integrated circuit;

a capacitor;

a core;

a bobbin having an internal dimension sized to fit over said core; and

a coil antenna helically wrapped about said bobbin and electrically connected to said integrated circuit and capacitor to form an inductive-capacitance circuit.

20. The transponder of claim 19, wherein said coil antenna is fixedly mounted on said core in a position whereby said inductive-capacitance circuit forms a tuned circuit.

21. A bolus for oral administration to a ruminant animal and for retention in the rumen or reticulum of the animal, comprising a magnet and a substance carrier.

22. The bolus of claim 21, wherein carrier includes at least one magnetically susceptible portion.

23. An animal confinement structure for determining feed conversion efficiency comprising;

a barrier with a plurality of openings for an animal to voluntarily walk through; and

a data collector adjacent to at least one of the openings.

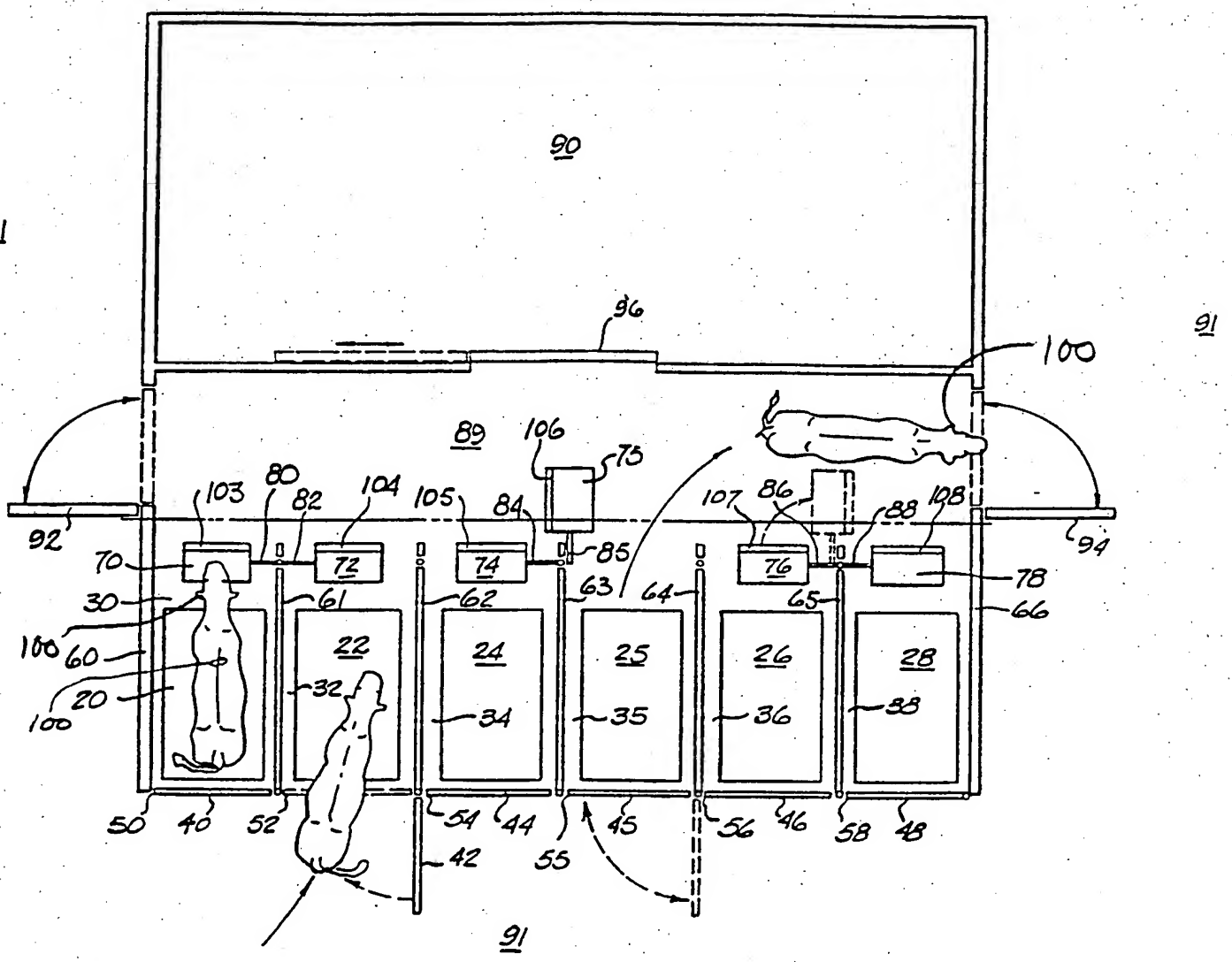
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Figure 1

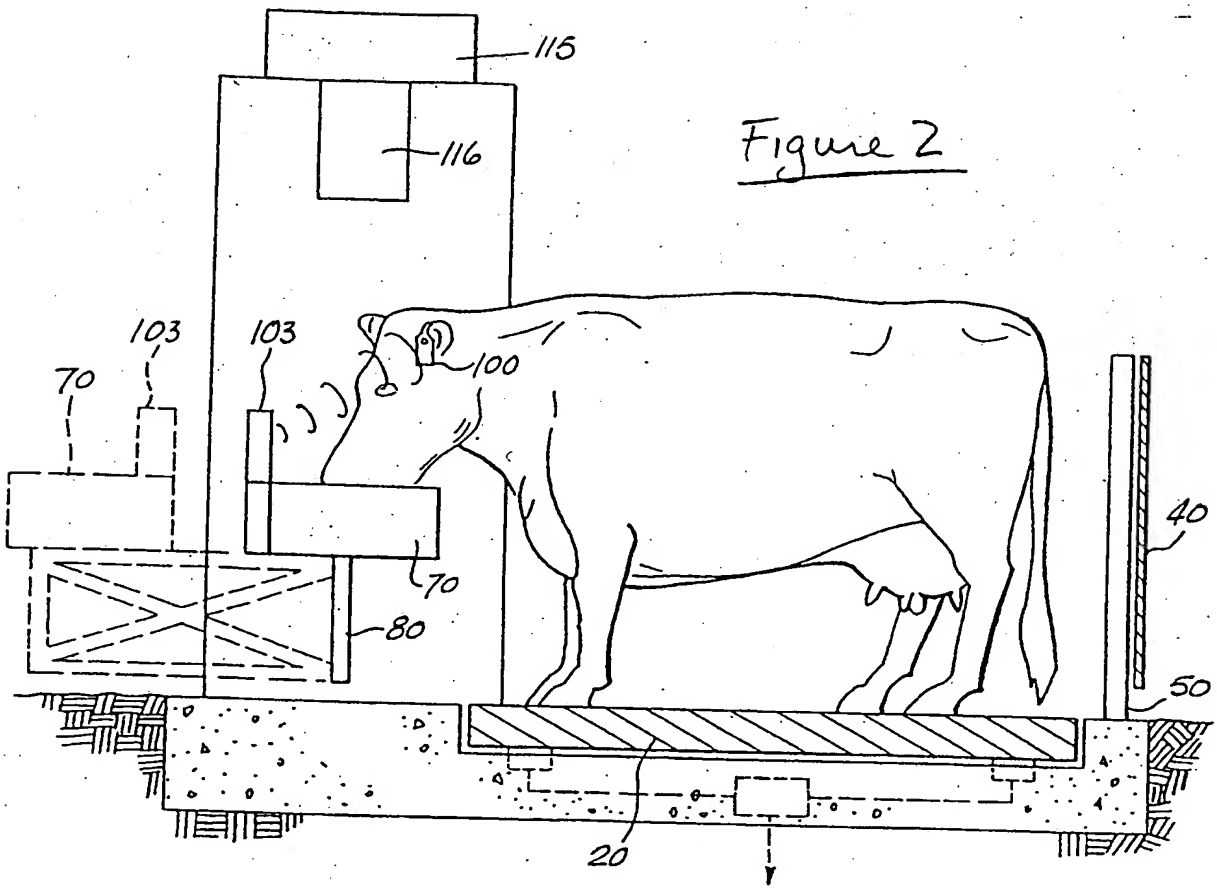

Figure 2

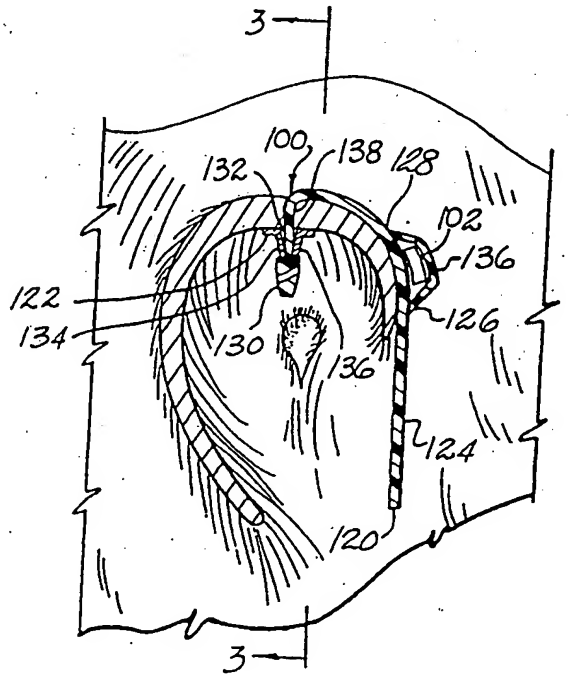

Figure 3

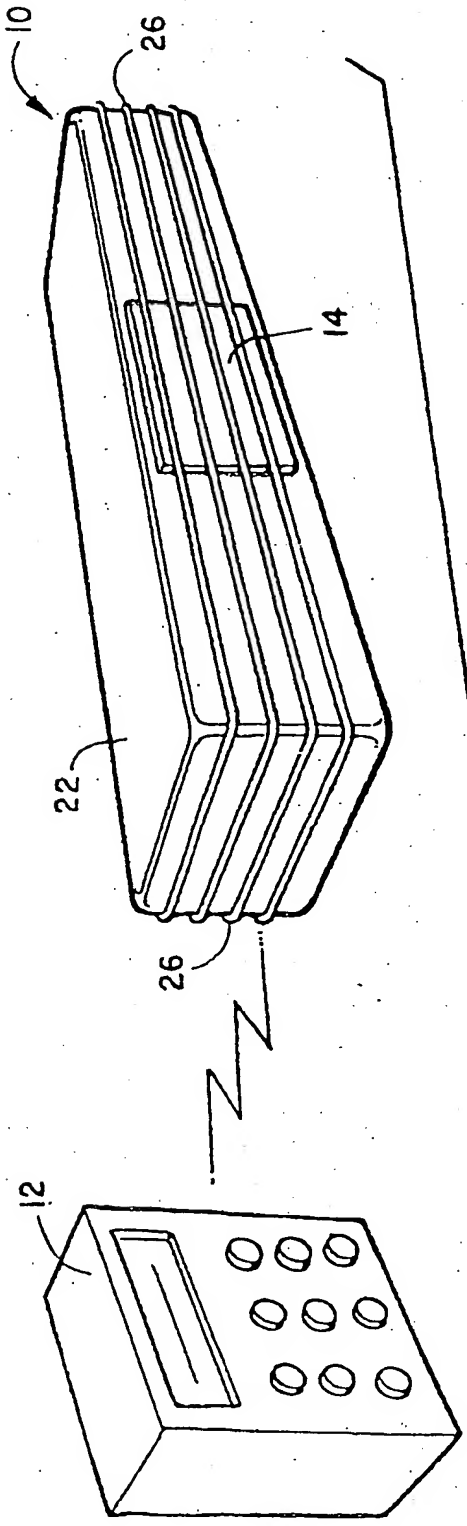

FIGURE 4

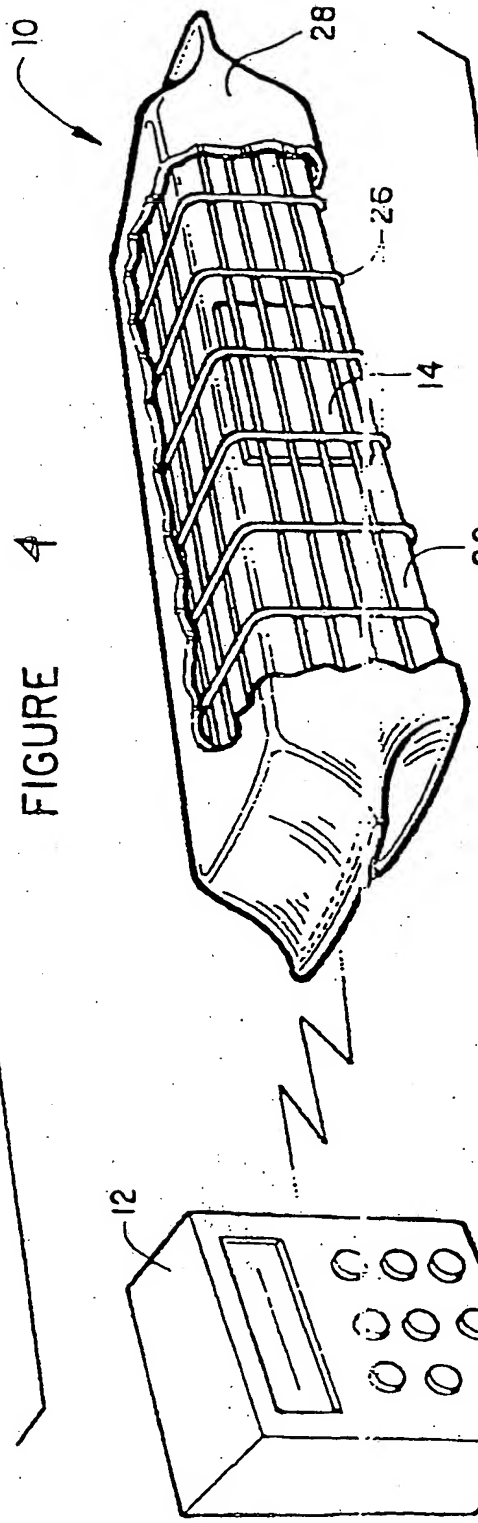

FIGURE 5

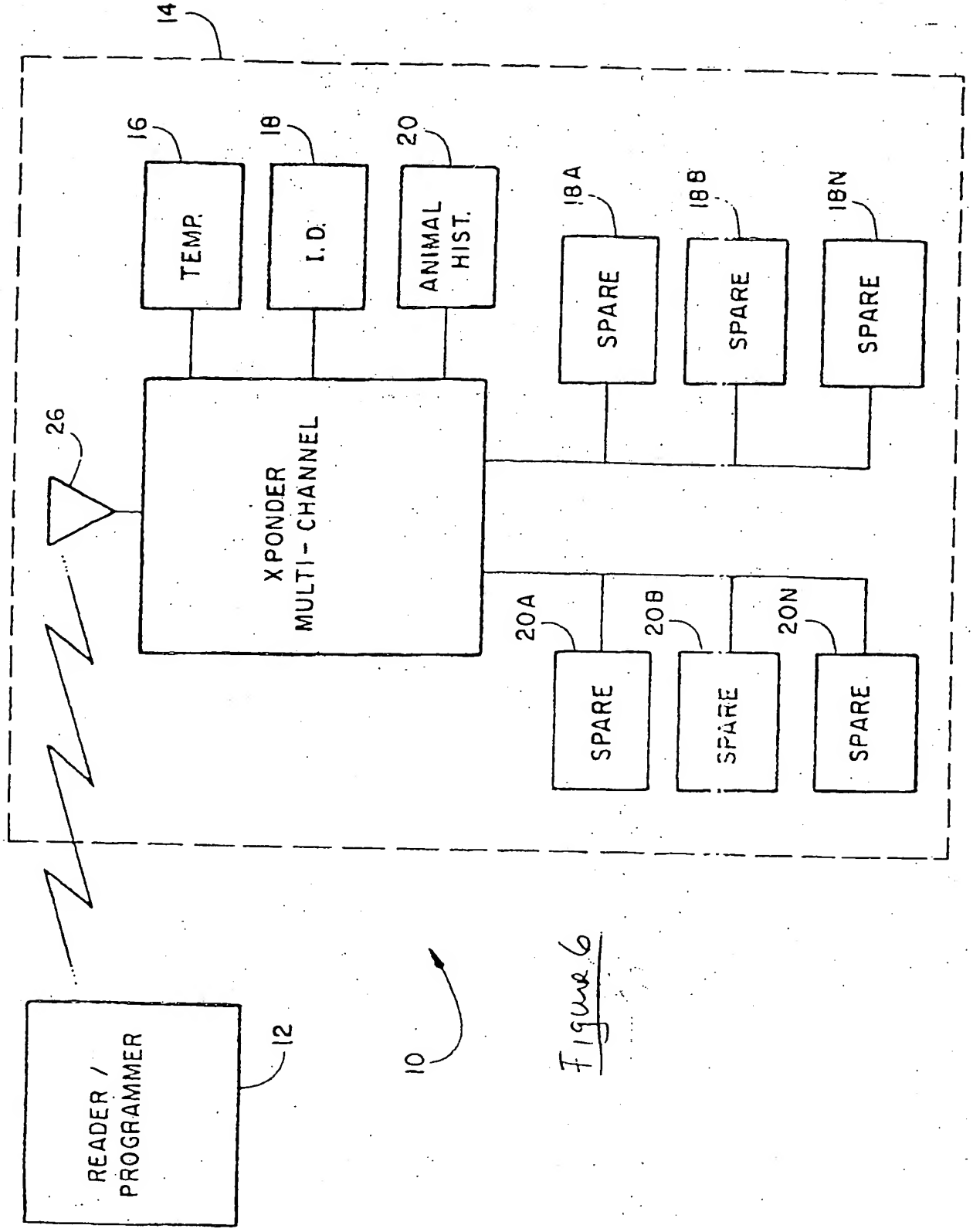
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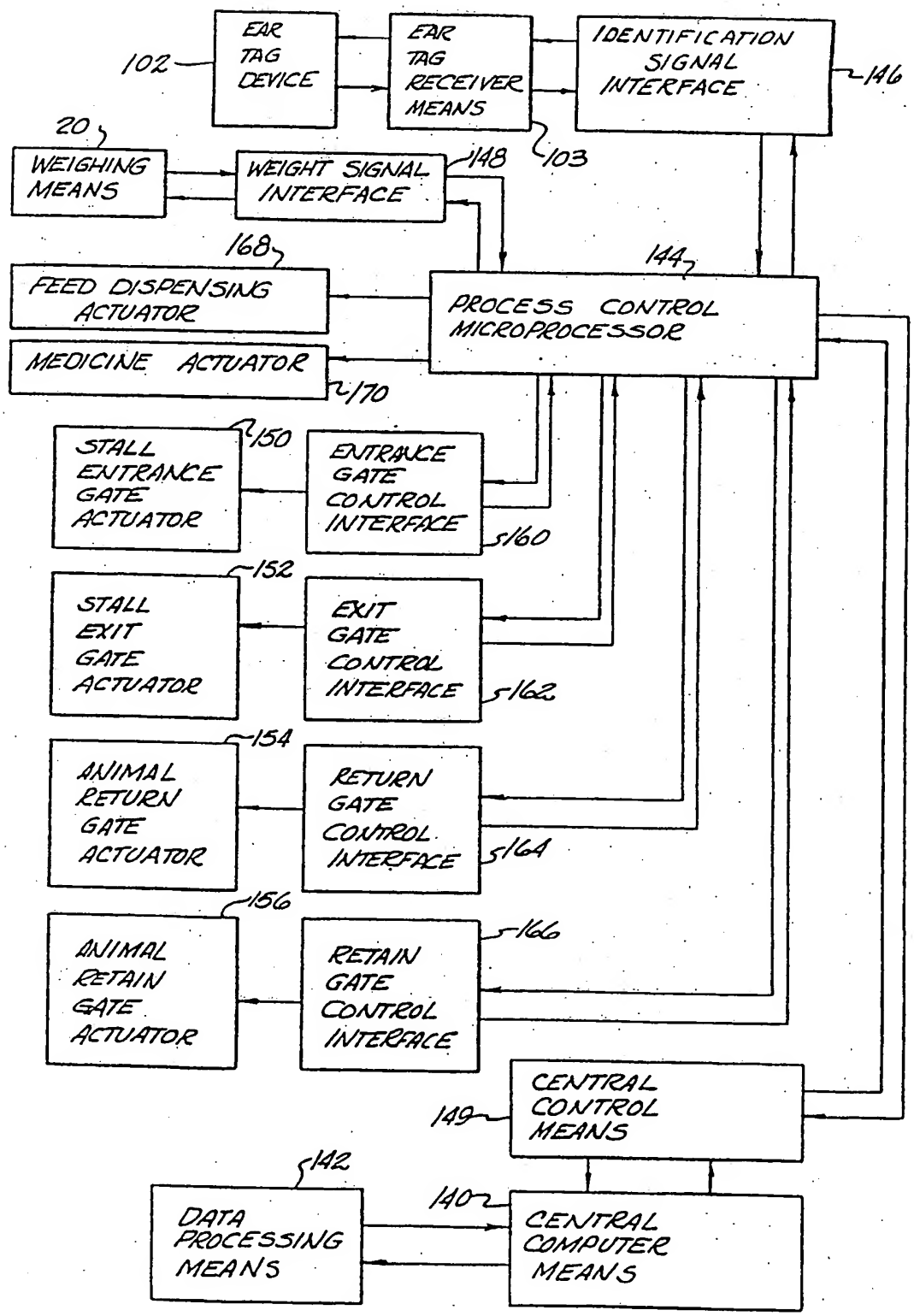
Figure 6


EAR TAG DEVICE
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EAR TAG RECEIVER MEANS
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146
20
WEIGHING MEANS
WEIGHT SIGNAL INTERFACE
148
168
FEED DISPENSING ACTUATOR
144
PROCESS CONTROL MICROPROCESSOR
MEDICINE ACTUATOR
170
STALL ENTRANCE GATE ACTUATOR
150
ENTRANCE GATE CONTROL INTERFACE
160
STALL EXIT GATE ACTUATOR
152
EXIT GATE CONTROL INTERFACE
162
ANIMAL RETURN GATE ACTUATOR
154
RETURN GATE CONTROL INTERFACE
164
ANIMAL RETAIN GATE ACTUATOR
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RETAIN GATE CONTROL INTERFACE
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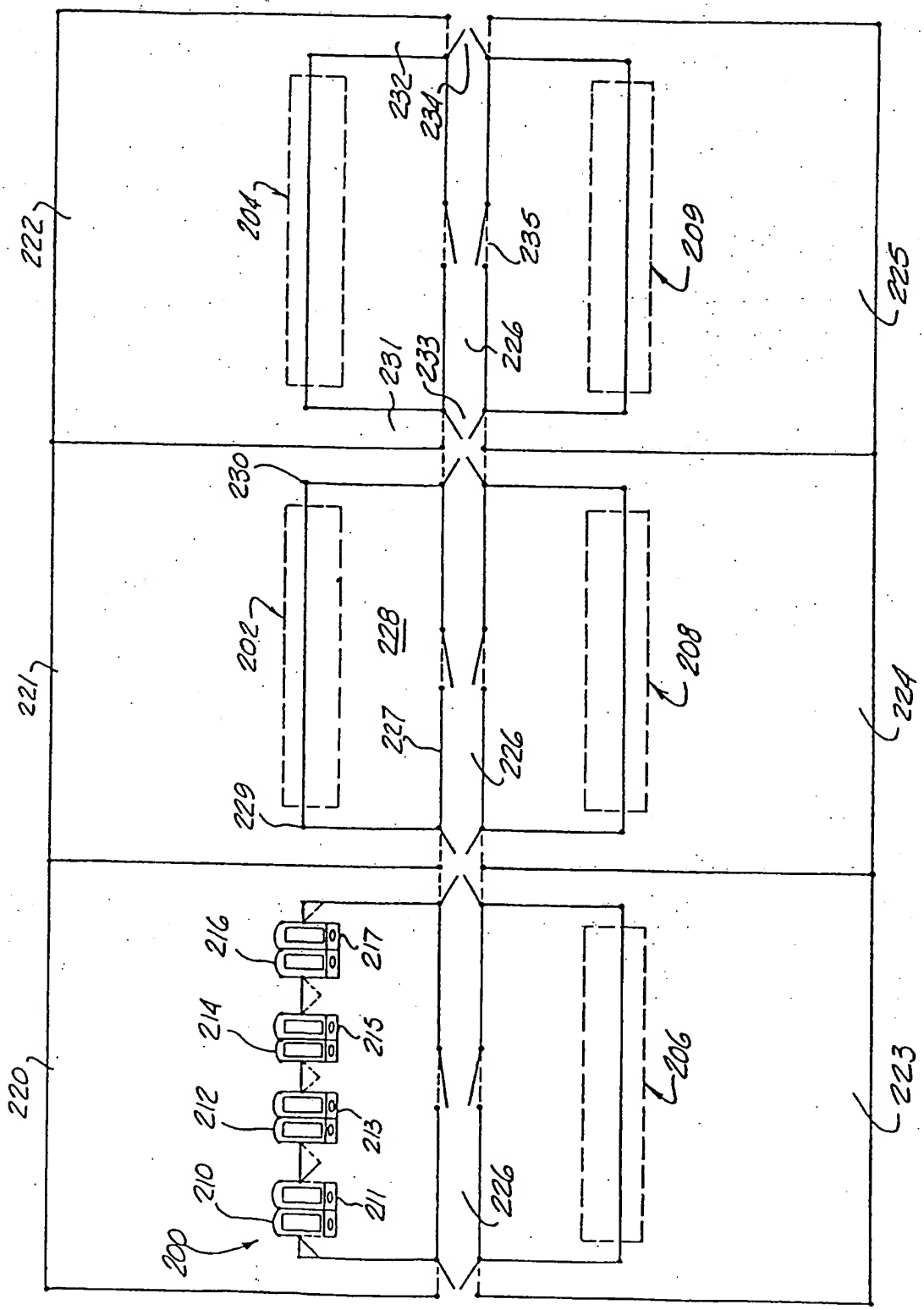
CENTRAL CONTROL MEANS
149
142
DATA PROCESSING MEANS
140
CENTRAL COMPUTER MEANS

Figure 7

Figure 8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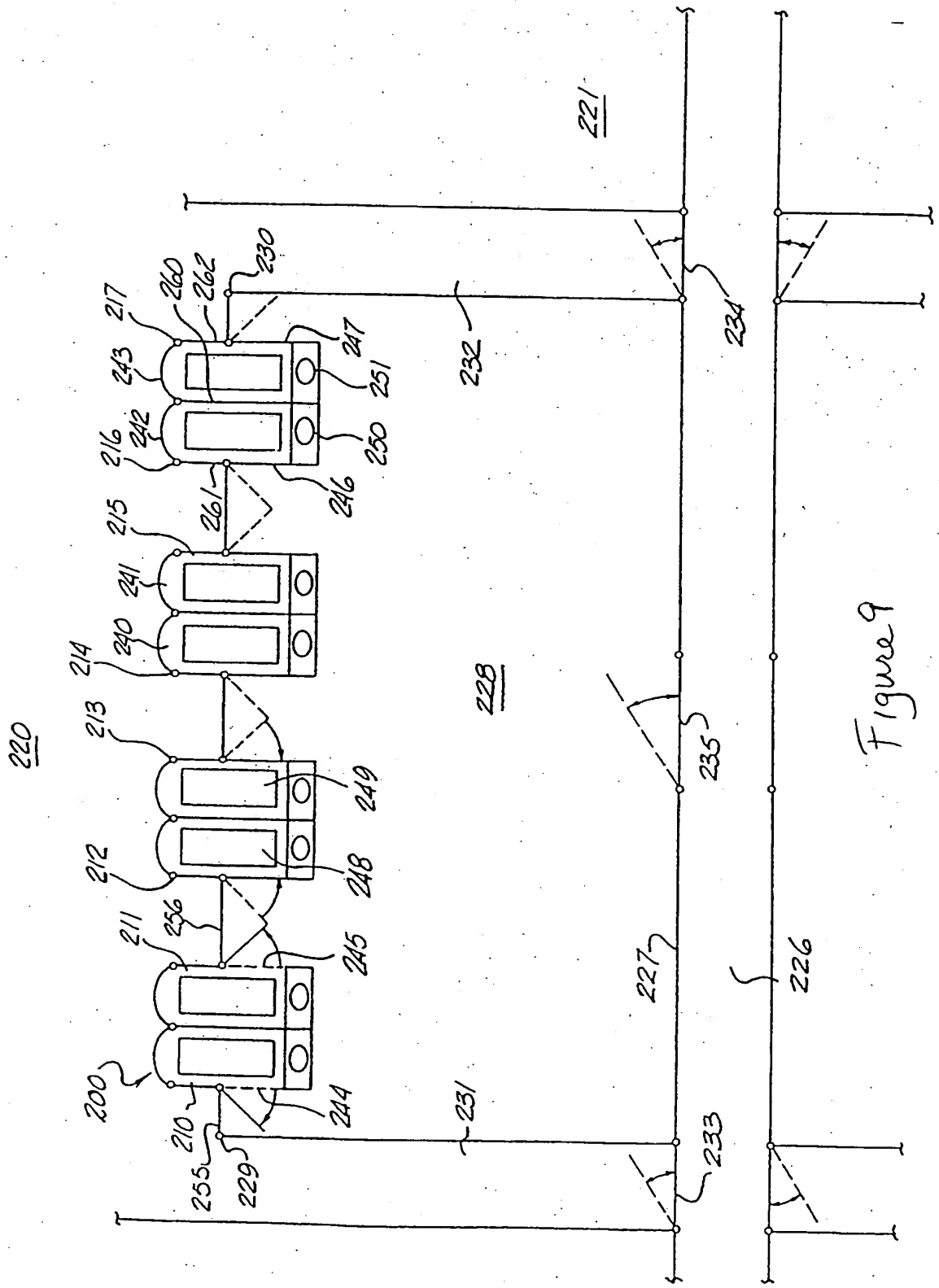
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Figure 9

Figure 10

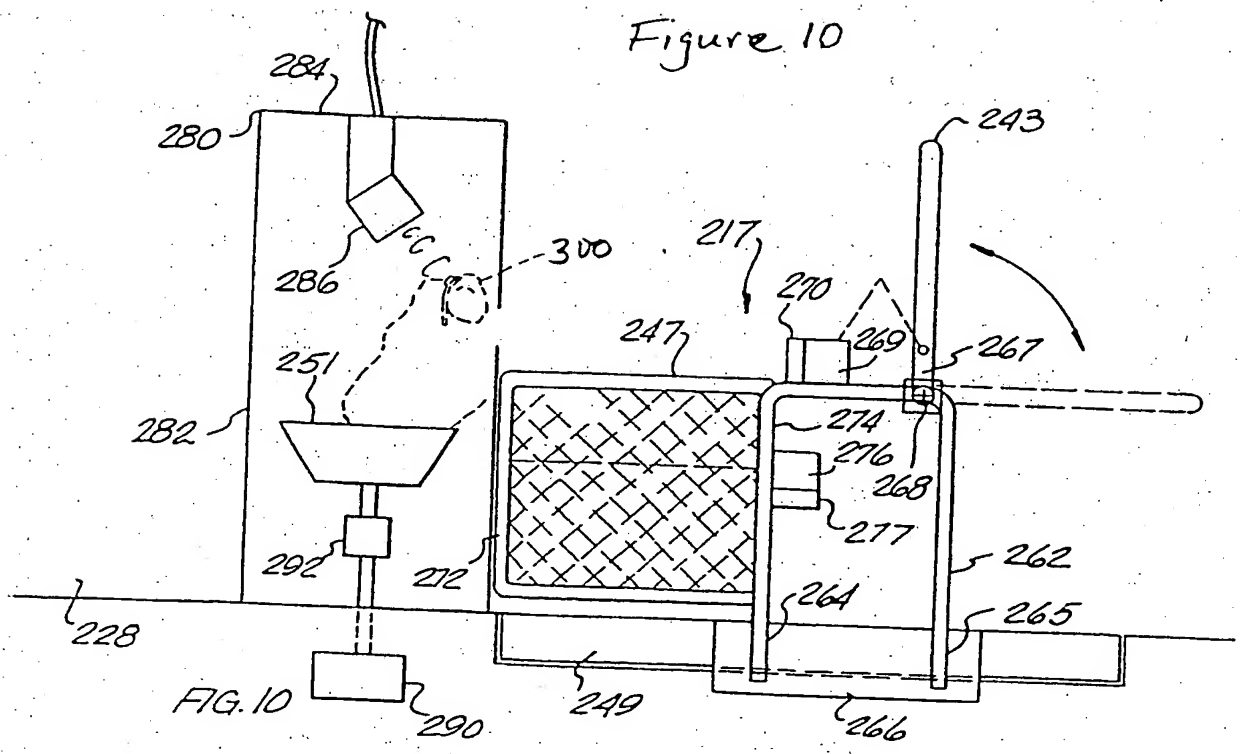


FIG. 10

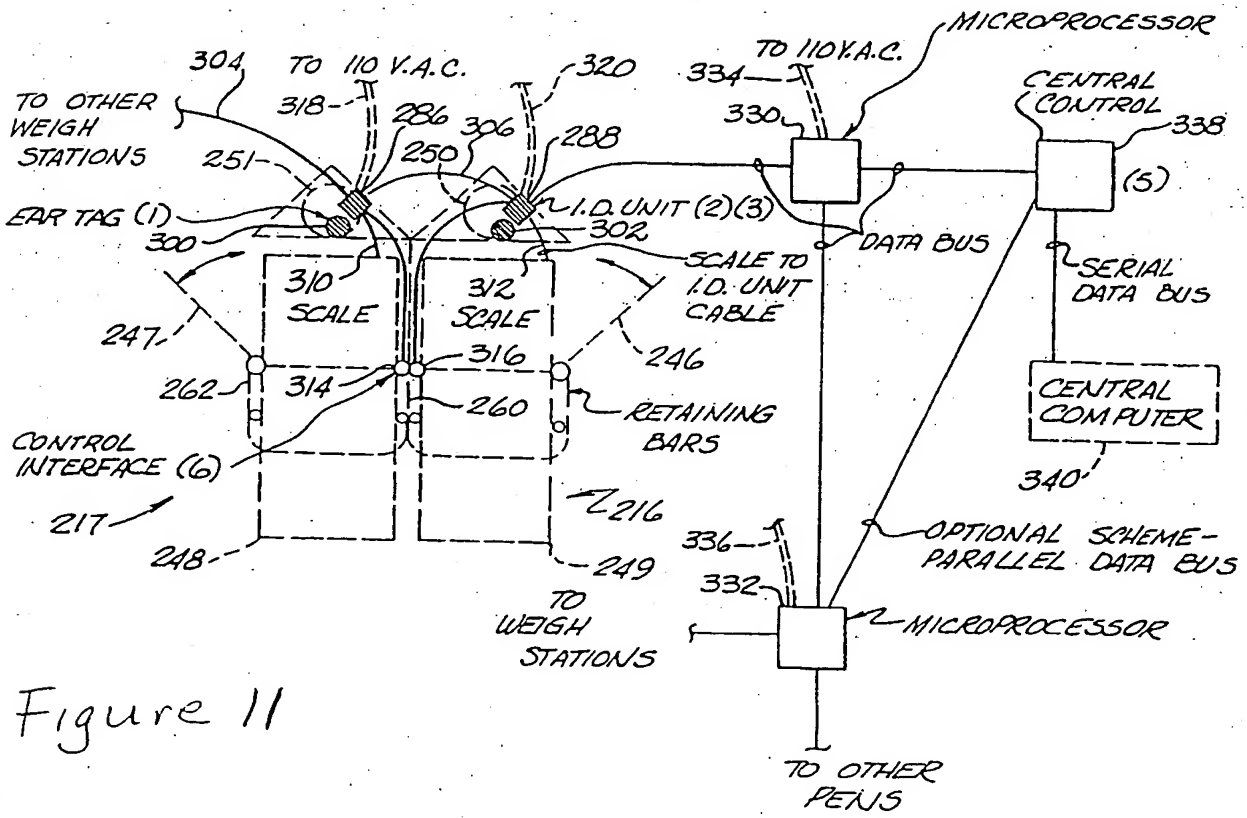


Figure 11

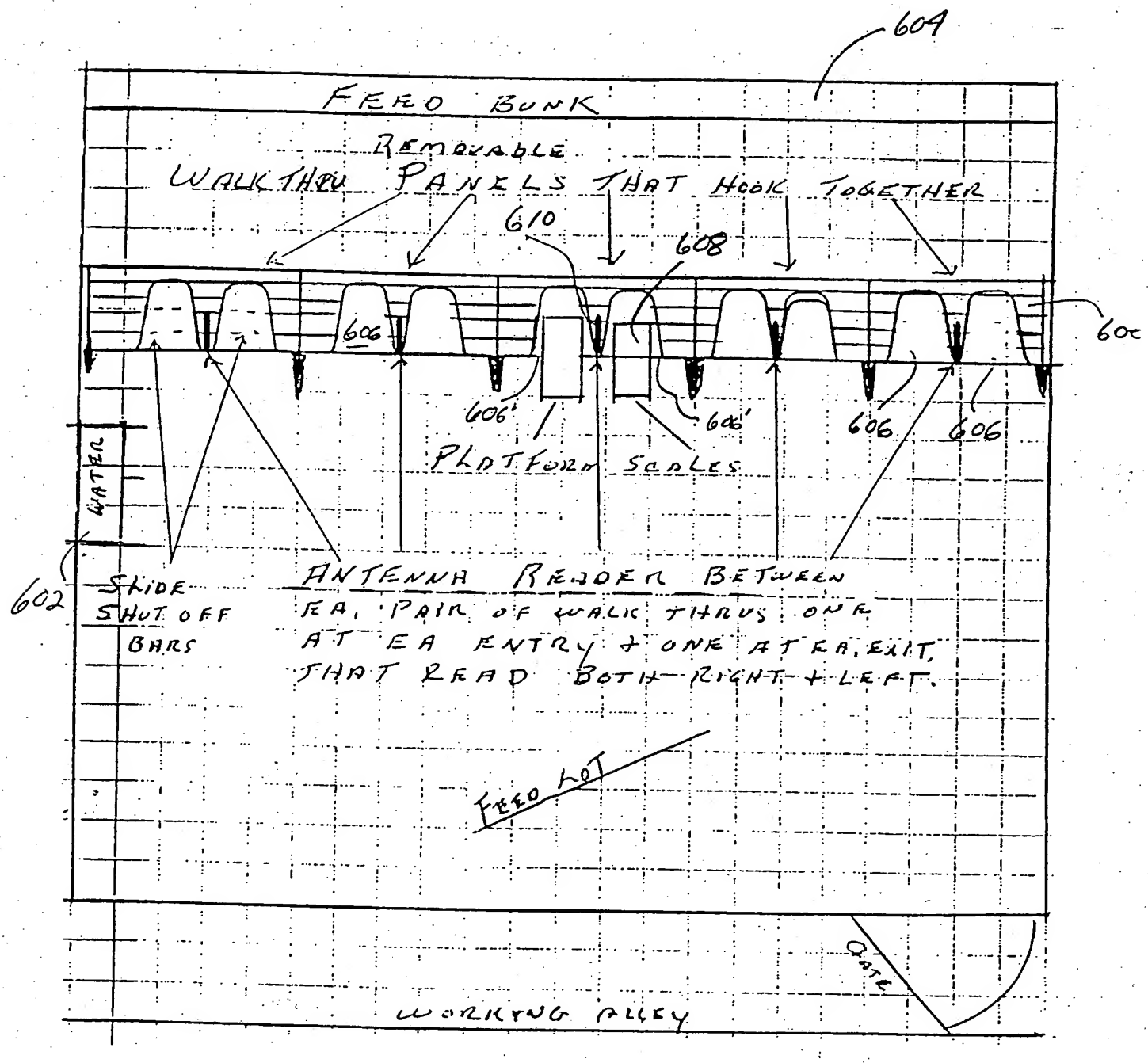

609
FEED BUNK
REMOVABLE
WALK THRU PANELS THAT HOOK TOGETHER
610
608
606
606'
606'
606
606
606
PLATFORM SCALES
WATER
602
SLIDE SHUT OFF BARS
ANTENNA READER BETWEEN EA. PAIR OF WALK THRUS ONE AT EA ENTRY + ONE AT EA. EXIT, THAT READ BOTH RIGHT + LEFT.
FEED LOT
GATE
WORKING ALLEY

Figure 12

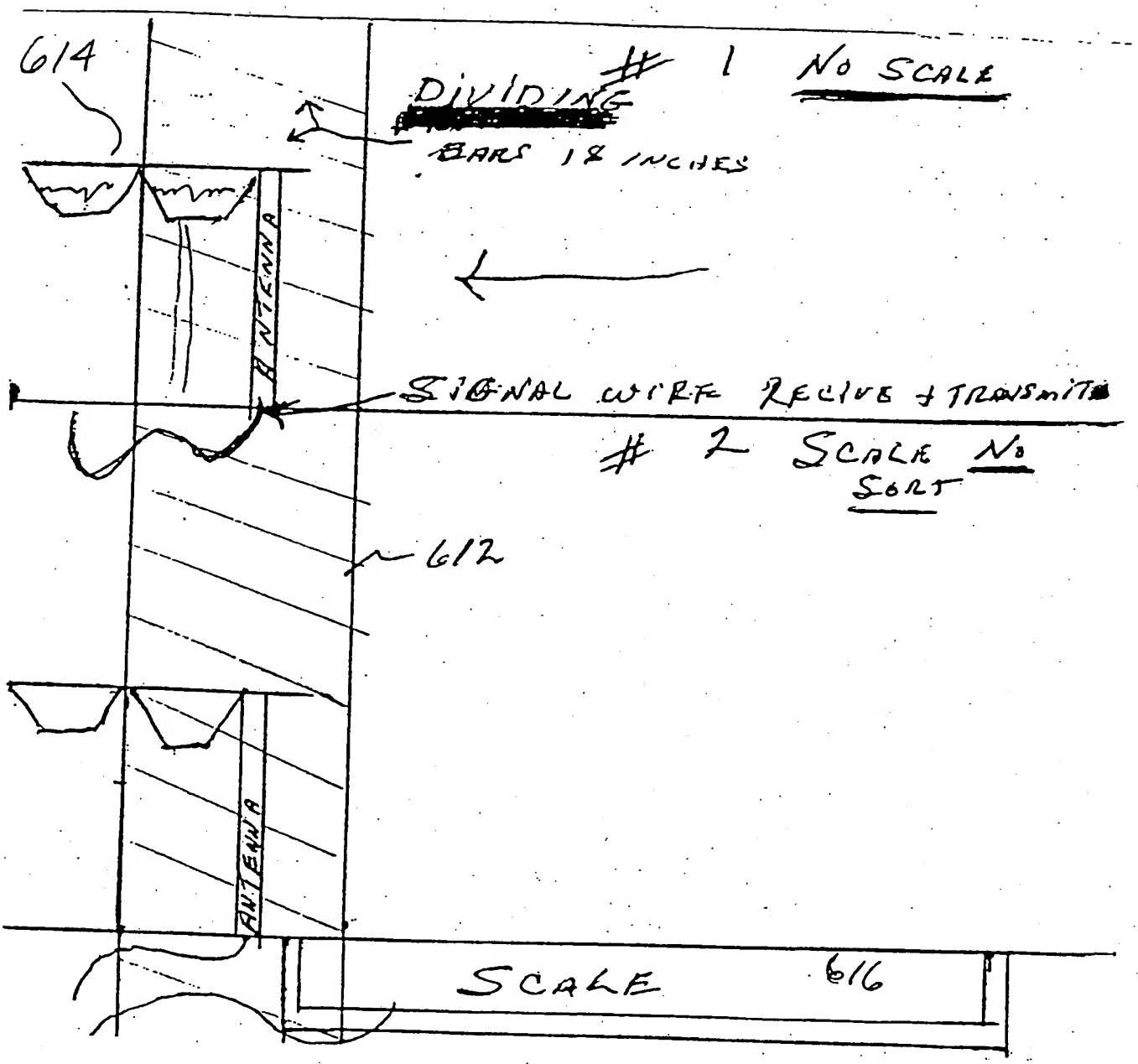

614
1 NO SCALE
DIVIDING
BARS 18 INCHES
ANTENNA
SIGNAL WIRE RECIVE & TRANSMIT
2 SCALE NO
SORT
612
ANTENNA
SCALE
616

Figure 13

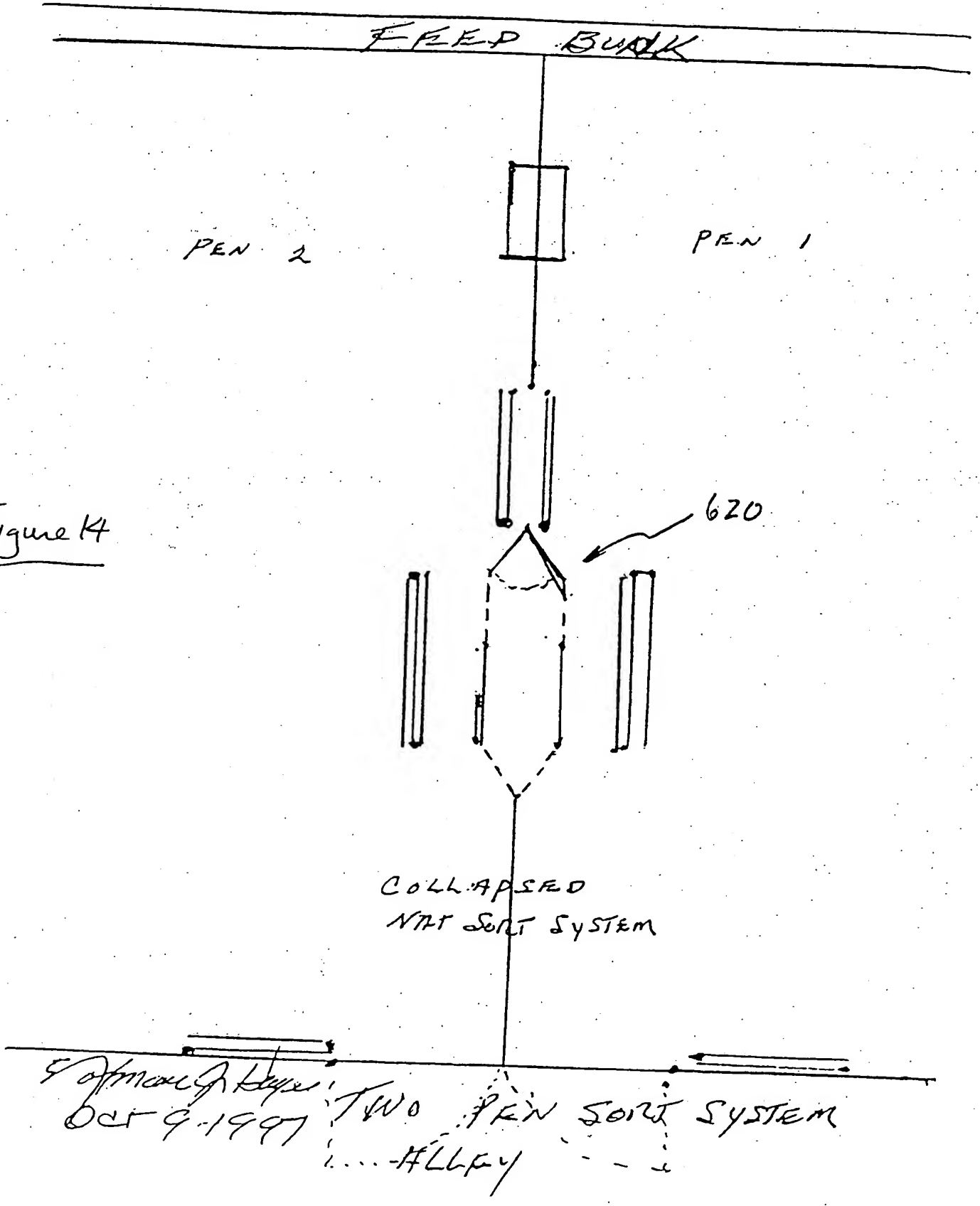

FEED BUCK
PEN 2
PEN 1
620
COLLAPSED
NAT SORT SYSTEM
TWO PEN SORT SYSTEM
ALLEY

Figure 14

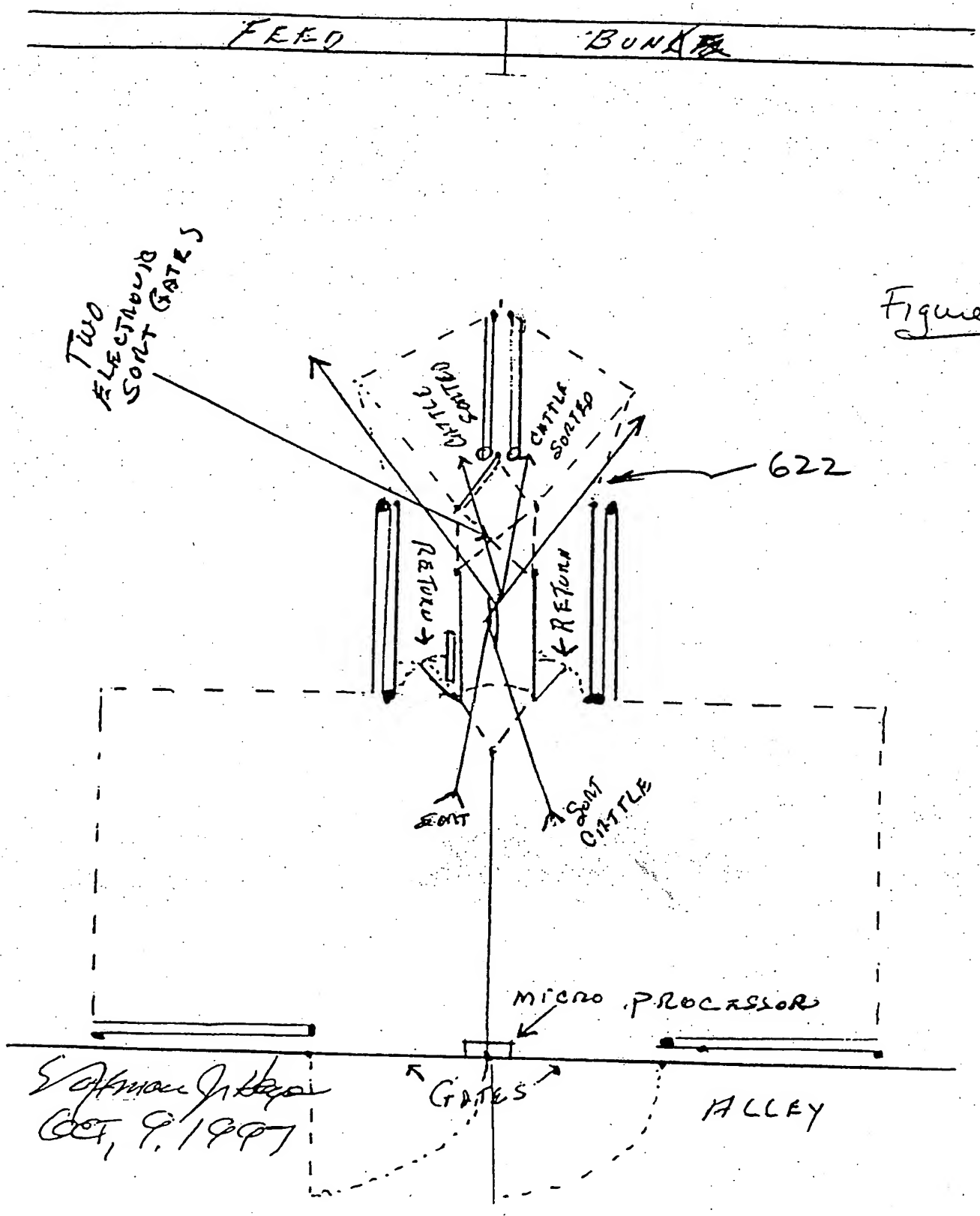
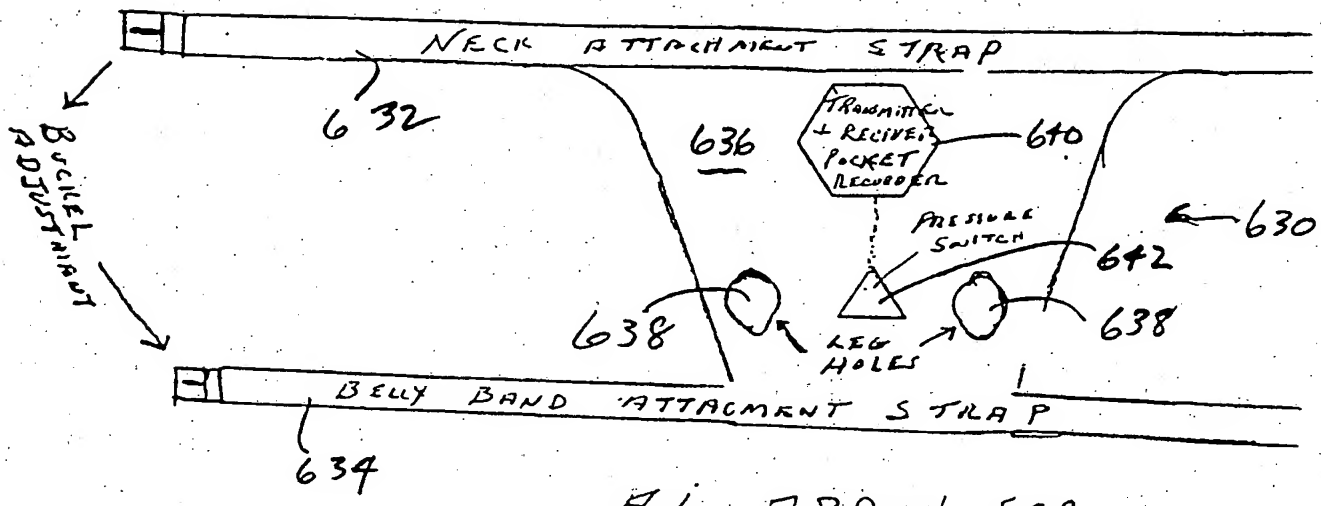


Figure 15

Oct, 9, 1997

Figure 16



A.I. APRON FOR VASECTOMIESED BULL

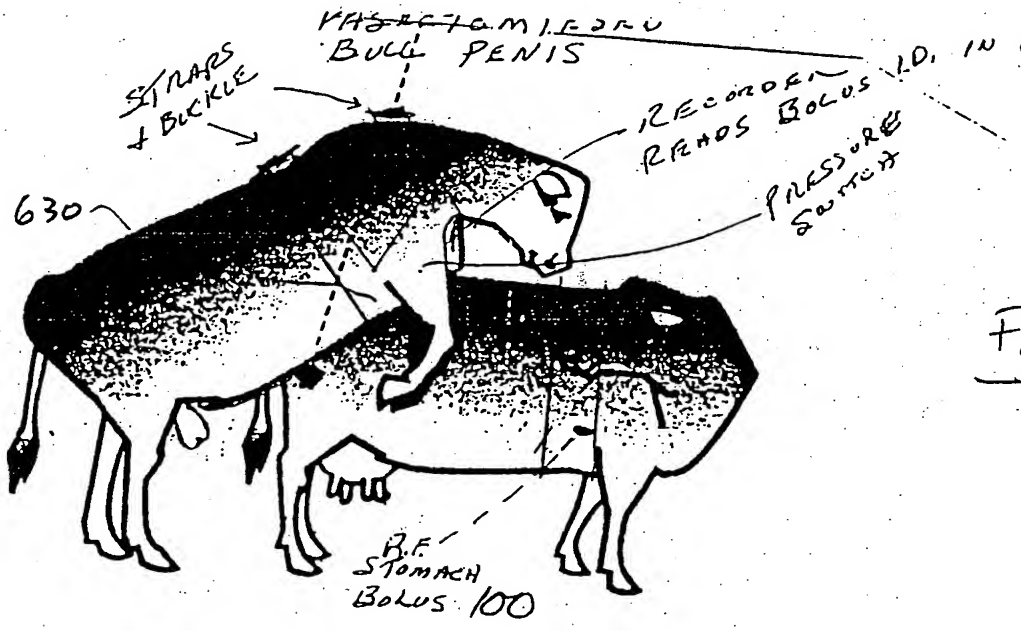


Figure 17

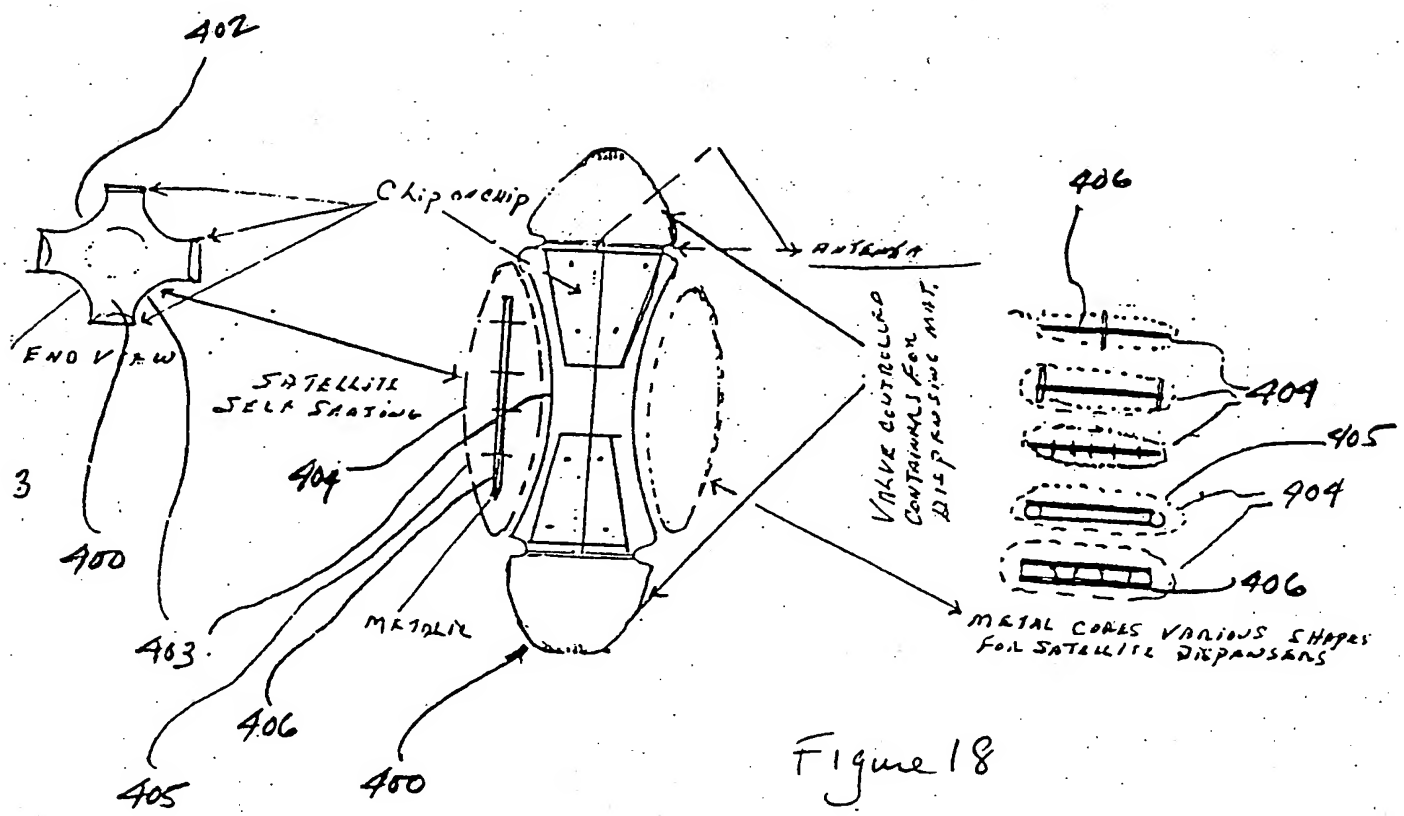

402
Chip on chip
ANTENNA
406
END VIEW
SATELLITE SELF SEATING
404
409
405
904
406
VALVE CONTROLLED CONTAINMENT FOR DISPENSING MIST
METALIC
403
406
405
400
METAL CORES VARIOUS SHAPES FOR SATELLITE DISPANSERS

Figure 18

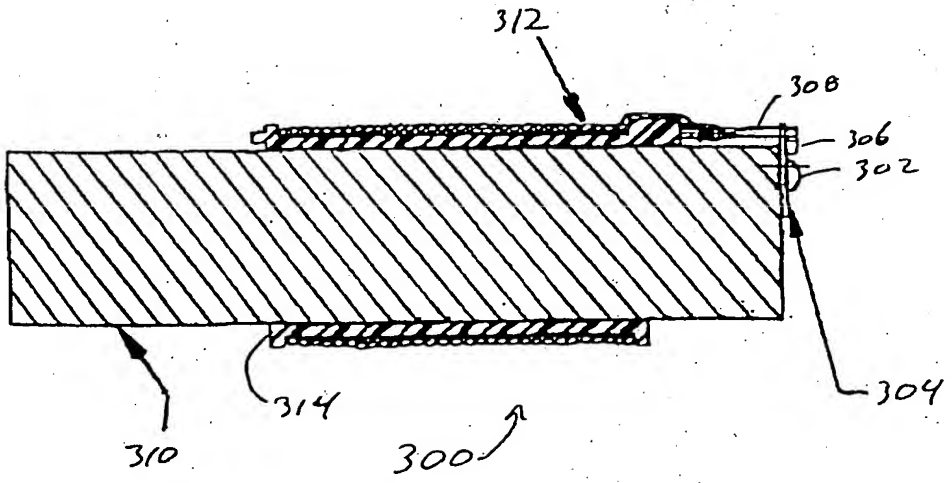


Figure 19

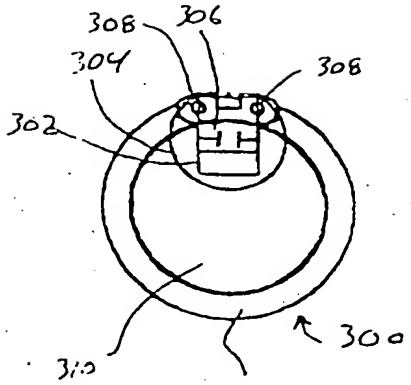


Figure 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/07916

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A01K 29/00
US CL :119/174

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 119/174, 51.02, 436, 502, 518, 842

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,322,034 A (WILLHAM et al.) 21 June 1994 (21.06.94), col. 6, lines 7-40.	1-4, 14, 15
X	US 4,617,876 A (HAYES) 21 October 1986 (21.10.86), col. 4, lines 40-68.	16-18
X	US 5,482,008 A (STAFFORD et al.) 09 January 1996 (09.01.96), col. 5, lines 40-64.	19-22
X	US 4,463,353 A (KUZARA) 31 July 1984 (31.07.84), col. 5, lines 25-52.	23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 JUNE 1998	13 JUL 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer for ROBERT P. SWIATEK Telephone No. (703) 308-2700

Form PCT/ISA/210 (second sheet)(July 1992)*